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# **SIMULATION TRAINING FOR FIBEROPTIC INTUBATIONS**

A doctoral project submitted in partial fulfillment of the  
requirements for the degree of  
Doctor of Nursing Practice

By

**KELLEY CLARK MOORE**  
MSN, Uniformed Services University, 1998

2013  
Wright State University Miami Valley College of Nursing/University of Toledo College  
of Nursing

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## ABSTRACT

Moore, Kelley Clark, DNP, College of Nursing and Health, Wright State University, 2013. Simulation Training for Fiberoptic Intubations.

Airway management is the cornerstone of anesthesia practice. Fiberoptic intubations (FOIs) are one advanced airway method that Certified Registered Nurse Anesthetists (CRNAs) must be able to use. However, the low volume, high risk nature of this skill may affect a practitioner's ability to perform this type of intubation. Despite this, no standardized training programs had been developed for this skill. The purpose of this project was to develop and implement an evidence-based educational simulation training program that allowed CRNAs the opportunity to practice safe FOIs and evaluate its effect on competence and self-confidence.

A review of the literature suggested the use of high-fidelity simulation as an evidence-based educational strategy to provide FOI skill training for a low volume skill in a risk-free environment. A training program was developed including three protocols for awake intubations. Nine anesthetists conducted a timed FOI on a high-fidelity mannequin prior to an evidence-based training program using simulation. The CRNAs then received a lecture and practiced FOI skills on the mannequins. Following training, participants completed another timed FOI and also completed the National League of Nursing (NLN) Student Satisfaction and Self-Confidence in Learning Questionnaire where intubation time, satisfaction, and self-confidence were evaluated as outcome measures.

Mean time to conduct FOI intubations decreased 52.87 seconds after the simulation training (difference between pre and post-training times:  $p=0.01$ ). Additionally, the

NLN questionnaire showed that students were satisfied with the formal educational program and there was a high level of self-confidence for the skill after training.

Results of this scholarly project showed that an evidence-based FOI training program for CRNAs using simulation can lead to positive outcomes of competence, self-confidence and satisfaction. The project indicates that a simulation training program can be successfully used as a standardized program for anesthesia providers for this important airway management skill.

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## **Acknowledgements**

To my committee members: Sherrill Smith, Donna Curry, Phyllis Gaspar and Erik Nelson, thank you for your support over these past years. Each one of you has helped immensely with good advice and sound guidance. A special thanks to Sherrill Smith who had the patience of a saint and never tired during this three year project editing and pushing me forward. This has been a wonderful learning experience and I look forward to continuing with other projects and promote future studies.

A special note of recognition and thanks to Teresa Millwater, the Simulation Coordinator at the project's training facility, who has been involved with the project from inception. Her positive encouragement and expert simulation knowledge helped make this new training program a success. Without her help, this project could not have been accomplished.

Another note of extreme thankfulness goes out to Lieutenant Colonel Karey Dufour who has been a tremendous source of inspiration. Her "eagle" eye and constant motivation helped me push forward with this project and my poster presentation.

Gary Curto, the illustration guru for Wright-Patterson AFB, was instrumental in helping with my poster presentation for this paper and a couple of research conferences. Although not feeling well during the time drafting the poster for this project, Gary pushed through with each and every edit that my advisors had to give! Mr. Curto, not only is fantastic at his job, was always pleasant with a smile and kind words despite my incessant, hourly revisions.

Additionally, I would like to sincerely thank DeAnne French PhD., the statistical consultant for this project. Dr. French graciously volunteered help with anything I

needed. I am amazed at how quickly she returned my data and her comments and critiques were so helpful. I feel very fortunate to have had her as my professor for my statistics class three years ago.

To my “life and sanity” saving friends Marie, Becky and Jeanette who met at local restaurants through-out the past few years, I want to say that I could not have made DNP graduation without your humor and support. I have made many new friends with this program; however, the three of you will also be in my heart and prayers from now on. I will never have another root beer float without thinking of you all. You have kept me going with words of encouragement and actions that truly depict what friendship is all about. All my love and thanks go out to you!

## **Dedications**

This paper is dedicated to my family who has put up with the piles of paper in our computer room, my incessant need to proof read another paper and the hours of family time lost due to this program. I will soon be “there” for all family events and obligations. Thank you for your patience as I fulfilled this degree. This degree honors you as well as me because I could not have accomplished this without your support.

To Tonya and Lisa, my two best Ohio girlfriends who have totally supported and encouraged me for the past three years of this doctoral program. I am so thankful to have you both in my life. Your prayers, thoughts and friendship have helped me more than you know. Without you, my time in Ohio would have been less than pleasant. You made this assignment, this degree and everything else, tolerable! Your humor, advice and loyalty have been a huge part in keeping me on track and faithful to the course! This degree has taken up much of my time and energy. Your words of encouragement are a deep source of what gave me the strength to continue. You both have put up with me not going out to dinners, events etc. because of homework and deadlines. Thank you for being my friends. God has blessed me with you both, I am so lucky!

## **I. Problem**

Airway management is one of the most important skills for an anesthesia provider. In an American Society of Anesthesiologists (ASA) closed claim study, adverse outcomes related to airway complications was the single largest class of injury to anesthetized patients (Abdelmalak, Makary, Hoban, & Doyle, 2006). Because such events are tragic for the patients, family members, and the anesthesia provider, efforts to improve intubations on difficult airways are of utmost importance.

The fiberoptic intubation (FOI) advanced airway technique is the gold standard in managing a known or predicted difficult airway and an essential skill needed for any anesthesia provider (Agro & Cataldo, 2010; Guglielmi et al., 2010; McNarry, Dovell, Dancey, & Pead, 2007; Pean et al., 2010). An awake fiberoptic approach is a safe intubation technique to use when confronted with a difficult airway and should be used as a first option in an anticipated difficult airway because there is a wide margin of safety (Davison, Eckhardt III, & Perese, 1993; Gerheuser & Gurtler, 2011; Morris, 2001). Additionally, awake fiberoptic tracheal intubation is the best choice for patients with a limited range of motion in the neck or those with cervical spine injuries (Yeganeh, Roshani, Azizi, & Almasi, 2010). Other difficult airways that should be managed with FOI include, but are not limited to, neuropathies or pain in arms or neck when moving, any limited range of motion of the neck, history of a difficult intubation in the past, big tongues, receding chin, big necks, cervical neck fusions, facial trauma and swelling, obesity, not being able to lie flat, no teeth, facial hair, and small mouth openings just to name a few. Following the publication of the ASA Guidelines (1993) on difficult airway

management, FOI among anesthesia practitioners increased and this technique has played a major role in managing the difficult airway ever since (Weiss & Deutschman, 2000).

A problem exists when anesthesia providers encounter difficult airways that require use of a fiberoptic scope when they may not be familiar or have enough self-confidence with this life-saving device to secure the airway. A survey in 2006 confirms the lack of sufficient FOI skills throughout the world and the lack of routine opportunity to use this technique contributes to the problem (Goldmann & Steinfeldt, 2006). Heidegger, Gerig, and Keller (2003) stated the successful use of an alternative airway technique such as FOI in difficult airways depends more on the experience gained with that technique during routine use than on the technique itself. Even though difficult intubations are rare (1%-4%) in elective cases in the operating room (Langeron, et al., 2000), they can develop into life-threatening emergencies and training is recommended to facilitate the application of skills in clinical practice (Schaefer III, 2004). No standardized training program had been developed for anesthesia providers at the site chosen for this project even though the skill had been identified as a regularly scheduled mandatory training task. The purpose of this project was to evaluate the implementation of an evidence-based educational simulation training program for fiberoptic intubations. This included the development, implementation and evaluation of a new training program for FOIs for nurse anesthetists at a local military hospital.

### **Background and Significance**

In the past, loss of airway or machine mishaps was the most dangerous crises for an anesthesia provider. Machines have improved over time but an airway crisis is still an anesthesia provider's worst-case scenario and respiratory problems are still a frequent



cause of adverse outcomes (Heidegger, Gerig, Ulrich, & Kreienbuhl, 2001). Thus, support for anesthesia providers to gain self-confidence and competence with FOIs is paramount for improving patient safety.

When a known difficult airway patient comes to surgery or the anesthesia providers think there is a difficult airway, they will often do an awake FOI because it is the cornerstone of airway management that ensures patient safety (ASA, 2003). Competency or the ability to perform this task safely and accurately is a mandatory skill for any anesthesia provider. An awake FOI is a safe method for ensuring correct placement of the airway without taking away the patient's ability to breathe in the process. Fiberoptic airway placement has become the safest way to intubate a patient with a difficult airway because the scope is the most flexible, least traumatic and minimally stimulating method. Once the fiberoptic scope is in the airway, the endotracheal tube (ETT) is threaded in place and the airway is secured. The anesthesia provider can see the anatomy with the scope and be guaranteed the correct placement of the breathing tube.

Flexible laryngoscopes are great for known difficult airways where one can take time to anesthetize the airway, pre-oxygenate the patient and have staff help with the intubation. However, there are issues with this technique. The scope is fragile and excessive bending can damage the unit. Additionally, the scope is not intuitive to use; by pushing the lever up, the scope goes down and vice-versa. Any amount of blood, saliva or vomitus in the mouth can obscure the view. The fiberoptic scope may be difficult to use if the operator is inexperienced, if there are secretions in the mouth, or if the patient's airway is not well anesthetized causing him to cough and not cooperate for the procedure (Benumof & Saidman, 1999). The laryngoscope is like any other piece of machinery; the

users need to have confidence and experience with the item in order to safely and effectively use the device.

Traditional approaches to learning the standard direct FOI laryngoscopy techniques are cadaver labs, operating room (OR) exposure and clinical rotations. All of these offer educational opportunities for normal patient intubations. However, the number of patients seen with difficult airways during an anesthesia rotation is limited and providers may not get many opportunities to practice awake FOIs (Jones et al., 2008; Robitaille, Williams, Tremblay, & Guilbert, 2008). While FOI is a core skill for an anesthesia provider, many complete their training without obtaining this necessary competency (McNarry et al., 2007). In a study of surgical errors leading to litigation, the leading causes were lack of both experience and technical competence; therefore, failure of training may be attributed as the cause of an adverse event implying a lack of competence in the person performing the skill (van Beuzekom, Boer, Askerboon, & Hudson, 2010). While this study is not specific to anesthesiologists, it has implications for a high risk, low volume skill such as FOI.

While most patients receive safe treatment, Canadian studies show that 7-12% of hospital patients experience an adverse event and that 30 to 40% of those events are preventable and in anesthesia around 80% of adverse events have been attributed to human error (Forster et al., 2004). Despite growing recognition of human error in anesthesia, there is uncertainty on how to train providers to mitigate this issue (Phipps, Meakin, Beatty, Nsoedo, & Parker, 2008)

In an article from Great Britain and Ireland discussing litigation related to airway complications, a data review over a 12 year period showed 67 airway related claims out

of a total of 841 anesthesia claims (Cook, Scott, & Mihai, 2010). Of these 67 European claims, 58 were closed and 49 led to a pay-out sum of £4.9 million pounds (approximately \$6,655,826.30). Specifically, six of these claims specified difficult airway as the causative factor. The take home message from the review of the anesthesia claims was that airway and respiratory claims lead to major patient harm and include disproportionately large amounts of money to the plaintiffs not to mention more than half of all the deaths from this database.

Therefore, it is of utmost importance that anesthesia providers need to be able to use fiberoptic scopes with confidence in difficult airway scenarios. Self-confidence is a trainee's degree of comfort in performing a procedure or in providing patient care evaluated by self-assessment (Nishisaki, Keren, & Nadkarni, 2007). The difficult airway is a high risk, low volume event but anesthesia providers need to intubate the difficult as well as the normal airways with competence and confidence. Bandura (1993) proposed a view of human functioning that emphasized the role of self-referent beliefs. He believed individuals possess self-beliefs that enable them to exercise a measure of control over their thoughts, feelings and actions. Additionally, Bandura believed that behavior can often be better predicted by the beliefs people hold about their capabilities than by what they are actually capable of accomplishing. Self-perceptions of the Certified Registered Nurse Anesthetists' (CRNAs) confidence and competence with the FOIs may help determine what they do with the knowledge and skills they have. The more CRNAs practice a skill in a positive environment, the more confidence they will have when performing the skill. People who regard themselves as effective, act think and feel differently from those who perceive themselves as non-efficacious (Bandura, 1993).

In order to obtain this must-have skill, several high and low-fidelity simulators can be used as an evidence-based approach for developing self-confidence and competence of healthcare providers (Crabtree, Chandra, Weiss, Joo, & Naik, 2008; Goldmann & Steinfeldt, 2006). Simulation has been found to improve confidence levels in many professions not just those in healthcare. Studies related to avionics, graphic design, gaming, automobile driving, and various types of surgeries related to simulation have identified the benefits of simulation including improving self-confidence (Backlund, Engstrom, Johannesson, & Lebram, 2010). Pilots take-off and land numerous times in a simulated cockpit before going in an actual expensive plane with people (Alinier, Hunt, Gordon, & Harwood, 2006). Flight attendants train on simulated airliners that fill up with smoke, and tilt back and forth. They practice giving instructions to passengers to jump on the air slides and then they actually jump themselves down an inflatable slide. Military members train as close to real world environments as possible so they are prepared for their combat deployments (Backlund et al., 2010).

Simulation is increasingly common in healthcare education and arguably improves health professionals' competency and promotes safe practice (Hogg, Pirie, & Ker, 2006). High-fidelity human patient simulators are computerized full-body mannequins that can provide close physiologic and pharmacologic results for whatever task is initiated. The high-fidelity simulators are used because they are a close facsimile to an actual patient. These simulators are used in many nursing and medical schools to provide objective, state-of-the-art technology to help prepare healthcare workers. The mannequins can mimic any age from newborn to elderly with any healthcare issue and are extremely realistic (Nehring, Ellis, & Lashley, 2009).

Skills that cannot be addressed through clinical practice can be created in a simulated environment. Undergraduate and graduate nursing students may not get a patient with chest pain in a scheduled clinical day or be able to work-up a patient with congestive heart failure but they can simulate what to do in those situations. Simulation allows the students to get immediate feedback while interacting with the simulated patient. All of this can take place with no harm to the patient or the practitioner; therefore, simulation can improve safety and provide a safe environment to practice new skills and technologies (Nishisaki, et al., 2007). Simulation can be a powerful tool to address patient safety concerns by developing confidence and competence in patient care skills. High risk, low volume skills like FOI are ideal for the simulation laboratory; anesthesiologists can manage the awake FOI and can make mistakes without any harm to a patient.

While there are several studies that use simulation for intra-operative emergencies for anesthesia providers, none are available to describe use of simulation with FOI and improvement of an anesthesiologist's confidence and competence. The use of the high-fidelity simulation experience was identified as a means for addressing a need for a standardized training program for learning specific FOI skills. By using high-fidelity simulation technology to develop an evidence-based training program, real world issues can be practiced without injury to an actual patient. This technology is identified as an evidence-based approach that could be used to develop skills needed by CRNAs for FOIs.

### **Problem Statement**

As a result of the need for anesthesia providers to be confident and competent in the use of the fiberoptic scope, the following clinical PICOT question was formulated:

Among licensed nurse anesthetists (P), how does completion of a high-fidelity simulation training program for fiberoptic intubations (I) as compared to before completion (C) affect short term level of confidence and competency with performance of the skill (O) following program completion (T)?

### **Summary**

Anesthesia providers at the military medical facility for this project did not have a defined training program for FOIs. The need for an evidence-based training program was identified. CRNAs will have the opportunity to practice a high risk, low volume skill set to increase their self-confidence and competence through the use of high fidelity simulation. The next chapter describes how an evaluation of evidence was used to develop a training program for CRNAs related to FOIs using high-fidelity simulation.

## **II. Evidence**

The evidence-based practice process can help address the clinical problem of limited real world cases for FOI competency development. This chapter describes how Larrabee's Model for Evidence-based Practice Change was used to enhance clinical competence and confidence of CRNAs through a FOI simulation-based training program.

### **Evidence-based Framework**

Larrabee's Model for Evidence-based Practice Change was used for this change process to enhance clinical competence and self-confidence with FOIs (Larrabee, 2009). This framework integrates quality improvement, use of teamwork tools and evidence-based translation strategies to promote adoption of a new practice (Melnyk & Fineout-Overholt, 2011). Larrabee's six step model integrated the process that included identifying a clinical problem and assessing the need for a change in practice, and searching the best evidence for designing, implementing and evaluating a change in practice. This model allowed for the opportunity to develop an evidence-based educational program for a set of advanced practice nurses in order to improve a practice and patient outcomes. Each step guided the project director through the entire process of an evidence-based practice change. This framework was chosen over other evidence-based practice (EBP) models because each step of the process was succinct and distinctly useful in developing an educational plan to ensure safe practices for awake fiberoptic intubations.

The project director, through a needs assessment, identified a desire for a training program for FOIs. The project director was able to gather best evidence, implement a new training program and to initiate a change in practice for the anesthetists by following

Larrabee's six step model for evidence-based practice change. Because this model was intended for planned changes in practice, the framework was ideally suited for this project since this would be a change in practice for the anesthetists. Larrabee's model guides practitioners through the entire process of changing and implementation to EBP, beginning with assessing the need for the change and ending with the integration of a change in practice (Larrabee, 2009).

**Step 1. Assess the need for change in practice.** A project's success is dependent on the stakeholder's participation. In the setting for this project, the CRNAs are the largest group of anesthesia providers so these practitioners seemed to be an ideal population to address for a practice change. In this initial step in Larrabee's framework, a pen and paper needs assessment survey was administered to nurse anesthetists in a Midwestern military treatment facility to identify training needs including FOI skills (Appendix A). The needs assessment identified a problem of lack of FOI training and indicated 100% of the anesthetists wanted more practice with this specific intubation technique. Of particular interest on the questionnaire were their responses to their last formal training program for FOIs. The answers ranged from two months to over 15 years with one stating, "No formal training since school." All felt that simulation would be an appropriate training platform for learning FOIs.

**Step 2. Locate the best evidence.** This step in Larrabee's process was to define the problem and use the PICOT question to guide the search for articles for the EBP project. A search for evidence was conducted using three databases and articles were identified and critically appraised. The ASA Task Force on the Management of the Difficult Airway recommends that clinicians become familiar with various techniques to handle



patients with difficult airways (Caplan, Benumof, & Berry, 1993). The search strategy for the literature review started with the key words FOI, simulation, confidence, competence and anesthesia. No specific matches using all the key words were found; however, there were over a thousand articles on simulation and confidence. The search was further narrowed with additional pairings of key words anesthesia, and FOI (Appendices B, C, & D).

**Step 3. Critically analyze the evidence.** Critical appraisals of relevant articles were accomplished for the purpose of addressing the PICOT question. Data from articles were placed into a table after being carefully critiqued and evaluated. Synthesis of the articles determined whether the strength of evidence supported a change in practice. The best evidence was scrutinized and combined with clinical judgment. The level of evidence was determined using Melnyk and Fineout-Overholt's (2011) rating of levels one through seven. The synthesis of the 10 articles found in the literature search is discussed later in this chapter.

**Step 4. Integrate the evidence and design a practice change.** The project director utilized the evidence to develop a practice change--a new training program for CRNAs related to FOI skills. The use of a high-fidelity simulation experience was identified as an evidence-based educational method for addressing FOI training and numerous high and low fidelity mannequins could be adapted for this training program. While there was no literature that specifically pertained to anesthesia using simulation to practice FOIs, the articles that were similar to the topic of simulation were evaluated and used as evidence to design the FOI training program.

This step also includes evaluating feasibility of the project. Based on the availability of high and low-fidelity mannequins and the simulation staff, the project was determined to be feasible and appropriate to answer the PICOT question and meet the identified needs of the anesthetists. The goal was to develop a level of competence and self-confidence for intubating awake patients with the fiberoptic scope.

**Step 5. Implement and evaluate change in practice.** A practice change of a FOI education program incorporating FOI airway protocols and high-fidelity simulation was put into place. Implementation of this program included setting up the program on a regularly scheduled day for training at the facility. The training program began with timed intubations before any training occurred. Next, a comprehensive difficult airway lecture was given and then the CRNAs practiced intubations on four types of airways using the high and low-fidelity simulators based on protocols developed for the program. Finally, another timed FOI was done at the end of the day of training to measure improvement in the skill. There were two evaluation tools used to review the training program: The timed intubations both before and after training and the adapted National League of Nursing Student Satisfaction and Self-Confidence in Learning questionnaire. Outcomes of competence (intubation time), satisfaction and self-confidence were measured to evaluate the impact of the EBP training.

**Step 6. Integrate and maintain change in practice.** Larrabee's final step is to integrate and maintain the change in practice. Nurse anesthetist's confidence levels, competency and satisfaction with learning were anticipated to increase after they practiced with scopes and the different protocols. A simulated advanced airway program was not only beneficial to the anesthesia providers but the training can be extremely

important in providing safe, quality care to patients. The change of practice was an implementation of a new program by using high-fidelity technology to safely practice FOIs. Sustainment of the training program for this military site is facilitated when the CRNAs are provided with the tools to be successful such as the difficult airway power point slides, the time to train in a realistic simulation laboratory, immediate feedback, and the protocols and training modules. The project director used the informal feedback from the actual participants to gain insight on the project's success. In addition, the feedback from the CRNAs could be used to initiate improvements for future training sessions.

After completion of the project, the project director went back through the implementation process and shared the results of project with the anesthetists at the facility and other military bases. The project director is scheduled to present poster presentations of this project at professional conferences. A modified schematic of Larrabee's framework using specific steps for this EBP project is seen in Figure 1.

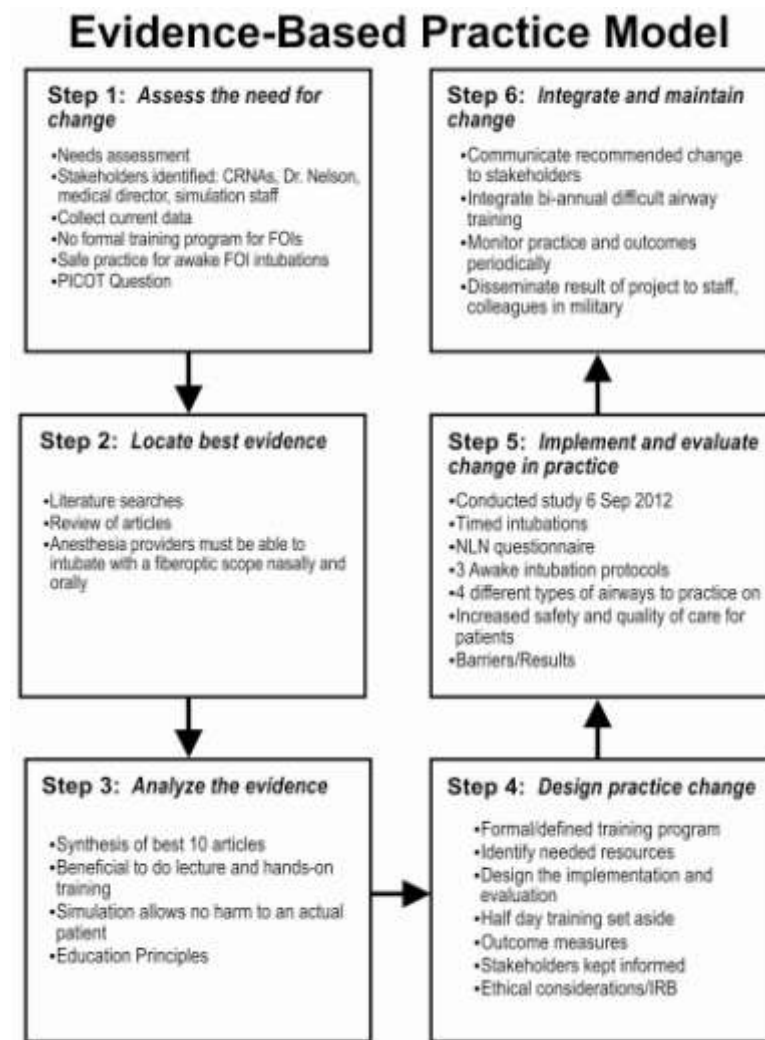
## **Literature Review**

After determining the needs of the population with an assessment survey, an exhaustive EBP literature search was completed. Simulations were defined as activities mimicking the patient in a clinical environment (Jeffries, 2005). Additionally, a review of educational principles was conducted to provide support to the project from an educational perspective.

**Search strategy.** Key words used in the search were from the PICOT question: FOI, simulation, confidence, competence and anesthesia. Since there were no specific matches for this topic, a variation of the key words was utilized. Also included in the database

searched data table was the rating system from Melnyk and Fineout-Overholt (2010) for the hierarchy of evidence.

**Figure 1.** Modified Schematic



*Figure 1.* Modified schematic of the model from Larrabee (2009) of evidence-based practice for the use with the simulated fiberoptic intubation project.

CINAHL, PubMed and Cochrane were used as the databases for the search. There were numerous articles on confidence and simulation; as a result, adding the words anesthesia or FOI narrowed the search. Several articles supported the use of simulation to improve confidence but none supported using simulation as a means to improve

confidence in using the fiberoptic scope with anesthesia providers. Unfortunately, there were no matches for simulation with anesthesia providers on FOIs and confidence levels. Therefore, the literature related to simulation for similar uses was examined.

**Inclusion and exclusion criteria.** Inclusion criteria encompassed anesthesia, FOI, simulation, self-confidence, competence after simulation use, and anesthesia. Once the articles were identified and evaluated, the exclusion criteria were set which included: Intensive Care Unit physicians, laryngeal mask airways, bronchoscopies, laryngeal damage, and surgeons. Articles with these factors did not pertain to simulation with anesthesiologists with fiberoptic scopes. No time frame or other countries were excluded. Searches were not limited to human studies; cadavers or animal studies using fiberoptic scopes or advanced airway training were included.

There were 539 hits with CINAHL on confidence and simulation and 2641 with the PubMed search. Adding the keywords anesthesia and FOIs refined the search. A few articles used novice physicians and measurement of self-confidence levels using simulation. Rationale for only using anesthesia providers was this EBP project did not deal with untrained hands in the airway. This project dealt with board certified anesthesia providers who were experienced with intubations and was aimed at their thoughts on the scope and their self-confidence in their skills after simulation. Other physicians were originally excluded from the search but were eventually allowed due to the limited number of hits with all the keywords.

Ten relevant articles were reviewed from the literature search. Although none of the findings pertained specifically to the PICOT question, they still remained pertinent and were included in the analysis for this project (Appendix E).

## **Needs Assessment in the Organization**

Support for the EBP project from key stakeholders was important to obtain from the beginning (DiCenso, Guyett, & Ciliska, 2005). Early identification of key players was necessary if the project was to succeed. The target population for this project was CRNAs at a military treatment facility in a Midwest City.

Individuals who are exposed to a new project or innovation will not incorporate that information into their practice unless they perceive the material as having value or relevance (Hassinger, 1959). Even though Hassinger stated this over 50 years ago, the premise remains just as relevant in today's world. For this reason a needs assessment was crucial to determine what the staff really wanted and then to honor the participants by giving them the specific requested training.

The needs assessment (Appendix A) was a paper pen, seven question handout and was distributed to each CRNAs mailbox. The forms were returned anonymously to the project director's mailbox. The needs assessment identified that use of the fiberoptic scope was sporadic; some had not used the flexible scope for years. The needs assessment also identified that there was no formal training program at this medical facility for FOI development. The providers wanted the FOI training but did not want to come in on their days off or stay after work to get the experience.

**Setting.** The medical facility for this project is a 90 bed military tertiary facility that has nine functioning ORs on the main surgical floor. There are approximately 300 OR cases done per month with specialties in general surgery, orthopedics, vascular, ENT (ears, nose and throat), plastics, urology, podiatry, obstetrics and gynecology. There are 13 nurse anesthesia providers as well as 9 anesthesiologists assigned to the surgical flight.

Nurses, technicians, and other support staff are also assigned. Permission for the project was obtained through the Investigational Review Board at both the military facility and Wright State University.

Training took place in the CRNAs own work facility and in actual OR suites. There are nine functioning ORs in the military treatment facility; however, usually only four to five are used on any given day. In this facility the first Thursday of every month is set aside for training with no scheduled cases in the morning. The project was done on a scheduled training day which meant that the anesthesia providers did not have to come in on a day off or drive to a different hospital to get the training as requested in the needs assessment. The OR rooms used for simulation were not going to be used at any time for patient care on the training day; therefore, the CRNAs could spend as much time as they wanted practicing FOIs on the mannequins as part of the training.

**Stakeholders.** There were four stakeholder groups for this project. Each stakeholder group was evaluated using then Power/Interest Grid for Stakeholder Prioritization (“Mind Tools LTD”, 2011). The main stakeholders were the staff nurse anesthetists (see Figure 2). These were the people who showed buy-in from the beginning. They needed to be motivated to learn and practice with the fiberoptic scope. Time spent in the simulation for practice had to be useful to the anesthetists.

Another key stakeholder was the senior anesthesiologist. He was on the project committee and worked at the medical center. This physician’s involvement from the beginning was vital. He is an airway expert, board certified anesthesiologist with 17 years’ experience who was consulted for the teaching materials and training tools for the project.

Figure 2. **Power/Interest Grid for Stakeholders Prioritization**

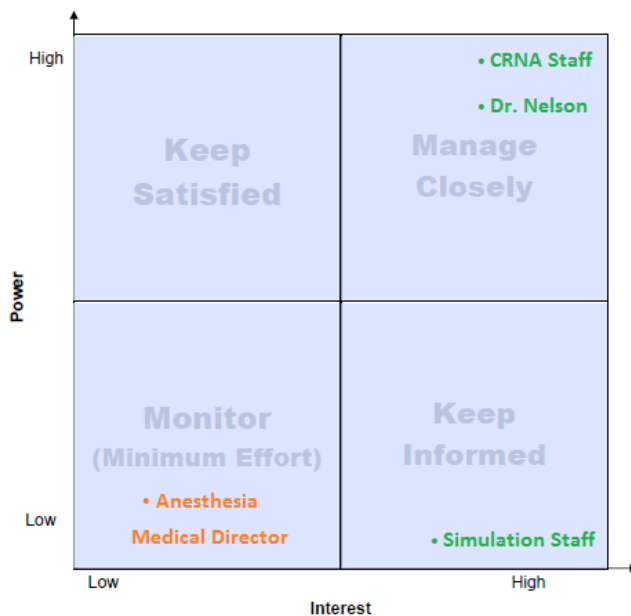


Figure 2. Power/Interest Grid for Stakeholders Prioritization (“Mind Tools LTD, 2011, from [http://www.mindtools.com/pages/article/newPPM\\_07.htm](http://www.mindtools.com/pages/article/newPPM_07.htm))

The Anesthesia Medical Director, one of the four stakeholders, was asked if she thought training with the fiberoptic scopes would be beneficial. She agreed the training would help all anesthesia providers. The medical director had low power and low interest, and was asked mainly as a consultant for this issue. She would not be involved in the project but was included as a stakeholder in case there were any concerns from the medical director’s standpoint.

The fourth set of stakeholders was the personnel in the simulation center, who have been involved from the beginning of this project. The simulation staff helped evaluate the mannequins for the use of their airways for training use of FOIs. The Simulation Coordinator and team have high interest in the project but they had low power. The simulation staff was kept informed on the project progress.



The senior anesthesiologist and the CRNA staff had high interest and high power in this grid and were managed closely. If either did not feel the project was worthwhile, they would not have buy-in and would put in minimal effort into the project. Keeping the key stakeholders interested in the training program was imperative to the project's success.

**Assessment of available resources.** The military facility has a dedicated simulation laboratory that is available to all personnel. There are several high and low-fidelity mannequins for use in maintaining or receiving clinical skills. Additionally, the three member simulation staff is available to set up the mannequins, help with training and run the computerized scenarios.

**Feasibility of change within this institution.** This facility was a training hospital for nurses, physicians and other professions and has a culture of supporting educational opportunities and new venues for learning. This medical center also places high value on patient safety, including identifying high risk, low volume procedures that necessitate new ways to achieve the experience and thus improving patient safety. A change to the betterment of educational programs was not only feasible, but encouraged by this organizational culture.

Military CRNAs are mandated to have advanced airway training every two years, which includes FOI skills, outlined in the CRNA readiness skills checklist used service-wide. Despite this, no formal training program had been developed to address this required need throughout the service. This requirement can now be met using this project's detailed training program.

## **Cost Benefit Analysis**

One of the advantages of this simulation program was no start-up or maintenance expenses. A need was identified and a plan was set in motion that used equipment and facilities already available. The simulators had been purchased several years ago. No additional computer programs or mannequins were needed. High and low-fidelity simulators are cost intensive. In fact, the most common constraint for simulation training is the cost. Although details depend on local circumstances, a high-fidelity simulator can incur a cost of \$245,000 or more (Turcato, Roberson, & Covert, 2008). Additionally, technical support, media equipment and trained faculty are also needed. Each mannequin can be attached to a computer that allows any number of physiologic responses. A trained simulation coordinator can work the computer so the mannequins can talk, change a pulse rate or any vital sign, occlude an airway or virtually any response according to what the student has done for an intervention.

Another advantage for this in-house simulation program was that no new days or times had to be set aside for practicing this skill because the hospital already had training days scheduled on the first Thursday of every month. No supplies had to be ordered because expired supplies from every area of the hospital were given to the simulation laboratory to use for their classes. If supplies needed to be obtained, a cost analysis of each item would need to be added into the project budget. Even though costs for a simulation laboratory are expensive, the questions leadership will need to answer are: 1) will the cost be worth providing help with the educational gaps and skills of providers?, 2) will the initial costs outweigh the potential risk of an untoward event?, and 3) will the use of simulation increase patient safety? (Okuda et al, 2009; Turcato et al., 2008).

Location of the training was in the OR at the military facility. The class was convenient for the anesthetists; they did not have to drive to another facility in order to get the training. There was no extra time or added cost to get the simulation training on awake FOIs. On-site simulation facilities can significantly increase the opportunities for nurses/physicians and other personnel for training. Hospital based simulation centers can bridge the gap in educational services as well as offer opportunities for staff to practice seldom used techniques or skills that they did not have the opportunity to train on during residency.

In addition, there were no specific financial payments from the hospital or to the CRNAs; however, the anesthesia providers were still receiving their hourly salary on the training day. The hand-outs and cost of time for the military personnel to attend the lecture was not an issue. The hospital believed education was important to medical workers and the half-day every month was set aside for training by facility leadership. Printers and supplies were available with no added cost for the project. The time spent on the training by the project director and the senior anesthesiologist did not add additional costs to the facility as both members are active duty military and receive a designated salary that includes education as part of their role. However, depending on the goals of administration and plans for the simulation center, the financial team needs to accept the cost of having full time employees to run the laboratory. A standard fee for a full time simulation consultant/facilitator starts at \$60,000 a year depending on educational background and the starting salary for a simulator operator is \$45-50,000 a year (T.M., Simulation Coordinator, personal communication, January 15, 2013). Additionally, courses to train the simulation educators at nationally recognized facilities

range from \$685.00 to \$1,995.00 (Turcato et al., 2008). Sharing simulation facilities or renting simulation resources is an option that can be considered to control these costs.

### **Analysis for Readiness for Change**

The anesthesia providers work rooms every day for eight to nine hours a day. There is no additional time left for projects or training on those days. Much of the training is done on the scheduled monthly training days where no cases are scheduled. As long as the training could take place on the training day, the CRNAs were eager for the FOI learning experience. The needs assessment identified an interest in FOI training for one of these training days.

### **Critical Appraisal of Evidence**

Critical appraisal tools were used to put the articles into a chart to assess the validity and strength of the evidence. A rating scale was used to stratify and evaluate the quality and level of evidence (Melnik & Fineout-Overholt, 2011). Level one in this hierarchy of evidence was the highest and level seven was the lowest confidence in strength of evidence. The synthesis of the 10 articles found in the literature search is seen in Table 1.

Table 1

#### *Synthesis of Literature Related to Outcomes of Confidence and Skills*

Author/year	Desired Outcome 1: Improve Confidence	Desired Outcome 2: Improve Technical Skills or Competency	Conclusion/Interpretation	Level of Evidence	Overall Rating by Project Director
Rowe (2002)	-----	↑	If providers timing and skills sets increase with simulation of FOI, it might be hypothesized that confidence levels also increase	2 (Well designed randomized control trials)	+++
Kovacs (2007)	-----	-----	Fiberoptic stylet airway adjunct has a higher success rates for difficult airway scenarios than the bougie	2	+++
Blum (2010)	↑	↑	Both sim groups and traditional laboratory groups improved in confidence and skills competence	3 (Evidence obtained from well designed control trials without randomization)	++
Baillie (2008)	↑	-----	Both sim groups and control	6 (Descriptive)	++

			groups increased confidence levels about their skills. Competence was not mentioned, however, it was noted that opportunities to make mistakes without harm to patients was a benefit.	analysis)	
Smith (2009)	↑	-----	Objectives need to be clear and simulation scenarios need to be appropriate. Although competency was not specifically addressed, students seemed to feel confident in their ability to take care of a patient in respiratory distress after practicing those scenarios in the simulation lab.	6	++
Goldman (2006)	—	↑	Time to intubation increased after practicing with a VR airway simulator, but it did not measure confidence levels.	6	+++
Davis (2006)	↑	↑	The rate of successful intubations and confidence levels increased after practicing in the sim lab; however, it was done with regular intubation techniques, not FOI	6	++
Russo (2007)	↑	↑	Course study on airway management show a self-reported increase in confidence and airway management	6	++
Chen (2008)	↑	↑	Specific questions on confidence were not asked, it was an “opinion” that confidence levels were increased	6	++
Cumin (2010)	-----	-----	Opinion of authors was that healthcare simulation needs accepted standards. The absence of standards undermines confidence in the results of any simulation-based endeavor and increases the risk of negative learning	7 (Opinion of authors)	++

FOI=fiberoptic intubation; VR=virtual reality; sim=simulation; ↑= article showed confidence or competence was increased; ----- = not addressed or not found;

Project directors rating of article scale:

+ = average; ++ = above average article

+++ = excellent article

Ten articles were evaluated and discussed. Out of the identified articles there were two level II, or evidence obtained from well-designed randomized control trials (RCT) and one article that was a level III or evidence obtained from well-designed controlled trials without randomization. The majority of the findings were level VI categories of evidence from single descriptive or qualitative studies, and there was one level VII article that was evidence from the opinion of authorities and/or reports of expert committees

(Melnyk & Fineout-Overholt, 2011). Based on the literature review there was evidence to support the use of simulation as an appropriate educational intervention to address the identified need for an educational training program for CRNAs on FOIs.

**Level II.** In the study by Rowe and Cohen (2002), two randomized sets of novice pediatric residents were used for the study sample. One group had no simulation training and intubated two consecutive pediatric cases. The second group did the same except they had simulation training. The performance was videotaped and graded on time to visualize the carina and the number and time the bronchoscope tip hit the mucosa. The simulation group's performance was markedly improved after the training. The control group showed no improvement between their two intubation attempts. The study showed the simulation was successful in training residents in the psychomotor skills necessary to intubate pediatric patients with a fiberoptic bronchoscope.

The second RCT study (Kovac et al., 2007), compared two airway tools and their effectiveness with difficult airways on a simulation model. The two aides were a bougie and a fiberoptic stylet. The bougie is a plastic tube with an angled tip and can be used to guide down the trachea and then thread an ETT over the device. The fiberoptic stylet is a rigid or semi-rigid tube with an optical fiber for light and image transmission and has a proximal eyepiece. Both are used with difficult airways. In this study there were two simulated types of airways used. One was a grade 3A view (easier) which means only the epiglottis was able to be seen and can be lifted up and away from the posterior pharyngeal wall. In the Grade 3B airway (harder) only the epiglottis can be seen but cannot be lifted up and away from the posterior pharyngeal wall. The Grade 3B airway was the more difficult airway to intubate. This study was designed to compare the

effectiveness of the bougie to a new fiberoptic stylet as an adjunct to facilitate tracheal intubation in a simulated difficult laryngoscopy situation in a mannequin. Participants were randomized to begin with either the bougie or the fiberoptic stylet. The 103 participants were respiratory therapists, paramedics, and medical students. No anesthesia providers were included in the sample. The intent was to examine the performance of the adjunctive tools in the hands of the relatively inexperienced user. Results showed that in the Grade 3A mannequin, both adjunct devices were virtually equal and good for time to intubation and in the grade 3B mannequin. However, the fiberoptic stylet was significantly more effective than the bougie in the more difficult airway for successful intubations. Participants were significantly more effective using the fiberoptic stylet on the more difficult of the two airway views than when using the bougie. The fiberoptic stylet is similar to the fiberoptic scope. Issues relating to cost, skill and maintenance of these devices limit hospitals from purchasing fiberoptic scopes; however, the bougie is relatively inexpensive compared to fiberoptic products. In addition, the stand-alone fiberoptic scopes have limitations because they require skills different from those used during direct laryngoscopy. A limitation of this study for this project was that this study used novice participants with fiberoptic equipment and not trained anesthesia providers.

**Level III.** In the only quasi-experimental, quantitative study found in the literature search, beginning nursing students (n=53) were evaluated to examine the relationship between simulation, student self-confidence and clinical competence (Blum, Borglund, & Parcells, 2010). Baccalaureate students enrolled in either a traditional clinical rotation or a simulation-enhanced experience during their first clinical term. Students were not randomized into groups due to schedule conflicts and prior commitments. The findings

show the need for further examination of teaching strategies to promote the transfer of confidence and competence from the laboratory to the clinical setting. The hypothesis was students using the high-fidelity simulator for training would have increased levels of self-confidence and competence as perceived by their faculty. However, they found that both simulation groups and traditional groups had increased confidence and competence regardless of which method of teaching was used. There was no information in this article on the nurses past experiences or a pre-confidence or skills assessment before they started this program. These results may reflect a masking of simulation-effect based on factors of student motivation, maturity and high educational attainment prior to entry into nursing.

**Level VI.** Six articles had a level VI rating. Most studies of skills laboratory and simulation were based on students' perceptions of the training. In Baillie and Curzio's (2008) descriptive level VI study, there were 267 nursing students who were either put in a simulation group or in a typical clinical for practice. Data analysis showed there were no significant differences between the perceived confidence of nursing skills between the simulation group and the comparison group. The authors found simulated learning during a clinical placement appears to be at least as effective as learning during regular clinical without simulation. The facilitators all agreed simulation enabled students to meet their learning outcomes. Most students wanted more practice time but were satisfied with their feedback using simulation. All the program facilitators and most students (93%; n=157/169) agreed that simulation enabled skills to be repeated which enhanced self-confidence. They also agreed (94%; n=159/169) simulation offered an opportunity to make mistakes and learn from them without harm to patients.



In the next descriptive level VI study, 68 nursing students participated in a simulated scenario in which an elderly patient with chronic obstructive pulmonary disease experienced difficulty breathing (Smith & Roehrs, 2009). This study used the Nursing Education Simulation Framework developed for designing, implementing and evaluating simulation used for nursing education (Jeffries, 2007). Of the five design characteristics, objectives were found to significantly contribute to the level of satisfaction. This article suggests that clear objectives for students were an important consideration for the faculty when using simulation experiences for nursing students (Smith & Roehrs, 2009).

Another descriptive study utilized 19 anesthesiologists, 15 residents and four staff physicians (Goldman & Steinfeldt, 2006). In this study, fresh cadavers and a bronchoscopy simulator were used to time the intubations. Results showed that after practicing with a virtual reality (VR) simulator, residents improved their time and were comparable to the expert anesthesiologist. Since airway management is an essential part of the anesthesia practice, every anesthesia resident must be able to intubate the anticipated or unanticipated difficult airway with a fiberoptic scope. Residents may not experience an adequate amount of difficult airways in training but anesthesia providers must still master those skills associated with FOIs, which can be accomplished with simulation.

Goldman and Steinfeldt (2006) go on to add that in most hospitals, current practice was to allow trainees to perform the FOI under supervision after they have had basic scope training in models or mannequins. Trainees may not acquire sufficient intubating skills to succeed in a complex airway situation with normal clinical rotations. Although the data suggest using a simulator aided in time to successful intubation, the data were

limited by the fact that intubation was not tested on live patients; therefore, the evidence was not clear if trainees could perform on real subjects with the accuracy they experienced with the simulator or the cadaver. The VR airway simulator offers an effective tool for training basic FOI skills in an environment that comes closer to reality than any other training modality outside the operating suite. Another value of this tool was the VR airway could be used for assessment of performance before allowing trainees to attempt FOI on a live patient.

In a fourth descriptive analysis study using air medical crews and intubation skills, simulation appeared to be effective for improving rapid sequence intubations (RSI) and decreasing the number of hypoxic events (Davis et al., 2006). Endotracheal intubations (ETI) have become the standard of care in prehospital environments necessitating the practice of these advanced skills for securing an airway. However, recent data suggest that desaturations, hyperventilation, and ETI failure occur with alarming frequency among both paramedics and air medical crews (Dunford, Davis, Ochs, Doney, & Hoyt, 2003). In this study by Davis et al. (2006) intubation success rates of air crews at Mercy Air Medical Services were examined. Mercy Air Medical Services includes 12 bases in Southern California and Nevada with approximately 120 flight nurses and paramedics. The first objective of this study was to see if intubation success increased after simulation training and the second objective was to see if self-confidence improved after the training. Improvements in competence and confidence were found. Increases in first attempt and overall ETI success as well as decreases in hypoxic arrests related to RSI were observed following introduction of the simulation curriculum. All participants thought simulation sessions should be a routine part of initial and ongoing training. In

fact, simulators were felt to be more effective than either didactics or cadaver training for the cognitive and technical components as well as the overall comfort level in airway management. The study was limited since the data were not on FOIs but results did show that simulation for intubations can increase skills and confidence levels.

Russo et al. (2007) found a one day simulator aided airway course for airway management had a significant impact on self-reported accuracy and confidence in evaluation of airways, use of alternative airway devices (including fiberoptic scopes), and changes in the practitioner's clinical practice with difficult airway situations. Out of 44 questionnaires that were returned six months after the simulator course, 86% reported they would attend a similar course again. Students rated the simulator sessions as having more impact than the lectures. This study demonstrated that a combination of lectures, skill stations and scenarios seems to facilitate transfer of knowledge skills into daily clinical practice. There were numerous limitations to this study. The questionnaires were anonymous so the type of practitioner who gained insight into the class could not be identified. Another limitation was that multiple airway adjuncts were used and so the results were not specific to FOI techniques alone.

In the last level VI study by Chen et al. (2008), 242 experienced nurse anesthetists and 13 residents were given a four hour renewal airway training program. Two hours were devoted to lecture and two hours were spent in a simulation laboratory reviewing several difficult airway scenarios. The questionnaire given at the end of the course revealed the renewal training program was useful and the participants gained more confidence and improved performance with airway crises. No data were reported on how fast they were able to intubate only that the course was useful and they felt better prepared for a difficult

airway. The authors concluded instructor based, real-time multimedia simulation was a fast, useful and systematic renewal educational method for many participants with extensive experience of airway management to update their knowledge on securing a difficult airway.

**Level VII.** In the tenth article examined as part of the literature review, a discussion was provided describing how simulation was now an accepted part of training in the areas of aviation, nuclear power and the military (Cumin, Weller, Henderson, & Merry, 2010). This article provided a discussion of how confidence in training outcomes in these areas was due to comprehensive and widely accepted standards. Simulation in healthcare may offer similar benefits if the clinical encounters could create an authentic experience. In the opinion of Cumin et al. (2010), the absence of standards for healthcare simulation practice undermines the confidence in the results of any simulation-based endeavor and increases the risk of negative learning. The authors believe simulation has positive benefits such as reduction in the risk of harm to staff members and to the patients. Simulation allows training to be standardized, the environment to be manipulated and controlled, and the use of feedback and reflection in a safe environment. However, the authors believe simulators in industries were similar to each other and results can be reproducible; one power plant or airplane should be similar to another power plant or plane which is not the case when dealing with human beings.

In this same article, Cumin et al. (2010) stated simulation-based physiology may be model-based, script-based or a mixture of these modalities. Script-based simulation is subject to operator error and bias. Model-based simulators theoretically eliminate these problems but the physiological responses may not be equally accurate. For most

purposes, simulator responses should be identical time and time again. But patients are not like airplanes. With each drug and each situation the patients may react differently depending on their own unique history. There is variability in human beings. Each patient can respond differently to the same drug or treatments depending on underlying disease processes. Still, the authors recommended that anesthesia and other relevant academic institutions implement standards to ensure simulation-based research was conducted with rigor, and testing of medical devices in a simulated environment can be relied upon to give useful results in the clinical setting.

### **Education Principles**

There are many types of learning strategies in which educators can choose to use in order to benefit different learners. Students may be visual, auditory, tactile or kinesthetic learners (Jeffries, 2007). Additionally, adult learners must be actively involved in learning activities (Reilly & Oermann, 1990). Active participation has been shown to enhance providers' critical thinking skills (Billings & Halstead, 2005). Simulation pulls all of these learning styles together in any scenario for the student. The simulation expert introduces the scene, briefs the student on the equipment and sets the guidelines for the use of equipment. The students listen to the description of the scenario and are able to assess the patient who is able to verbalize their signs and symptoms and interact with the students. Generally, the simulation expert is in another room or behind a screen so that the students are alone with the "patient" and cannot look to the simulation faculty for guidance. The students must respond to this patient as if they were really in the environment where they would take care of the situation on their own.

The medical professional whether an undergraduate student or graduate student is an adult learner (Okuda et al., 2009). The adult learner uses five principles: 1) adult learners need to know why they are learning, 2) they are motivated by the need to solve problems, 3) their previous experiences must be respected and built upon, 4) the educational approach should match the diversity and background of the learner, and 5) they need to be involved actively in the process (Bryan, Kreuter, & Brownson, 2009). The more realistic the scenario and the environment, the easier it is for the student to become engrossed in the actual care of the patient. If the student treats the mannequin like a real patient, the scenario becomes more life-like and problem solving can occur. Each intervention will bring on new vital signs and patient outcomes. Their previous decisions determine if the patient gets better or deteriorates. No matter what the student decides to do, the trained simulation expert will adapt the mannequin and adjust the hemodynamics accordingly.

Simulation provides many benefits and is gaining acceptance as a viable method used to teach healthcare workers (Aggarwal et al., 2010). Simulation is a mechanism for repetitive task practice and allows the educator the ability to integrate a simulation program into any curriculum. Various degrees of difficulty can be used in simulation; training can be for the novice or the expert practitioner. Each scenario can be varied and altered depending on the specific skill needed. Active learning takes place in the simulation laboratory with the benefit of using auditory, visual and tactile learning techniques. Feedback is immediate and the student can validate and reflect on the experience. The adult learner builds on previous experiences and is actively involved in the entire process.

While learning can be enhanced with simulation, there are cases that show this does not occur (LeBlanc, 2012). Some elements that enhance learning can be used along with simulation to optimize the simulation-based training. One element that seems to enhance simulation learning is debriefing. Debriefing has been shown to be a critical element in the success of task performance (Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005). The specific format of debriefing may have minimal impact, but the debriefing session no matter if video assisted, or faculty or student led sessions, has shown to improve skills in subsequent learning scenarios (Boet et al., 2011).

Debriefing is recommended immediately after the simulation experience to encourage reflection and ensure appropriate learning objectives have been attained (Jeffries, 2007). Debriefing has two main benefits: 1) debriefing is used for emotional support to help the student with supportive, immediate feedback, and 2) debriefing is used as part of the educational factor to provide the learners the opportunity to talk about the experience with respect to both the technical skills and the emotional effect of the simulation experience itself (Riley, 2008). Reflective thinking during the debriefing allows learners to assess their actions and discuss issues and concerns with the simulation event (Henneman & Cunningham, 2005).

One of the central tenets for simulation is that simulation allows for deliberate practice of a specified skill (Perkins, 2007). Task training can be done over and over to attain excellence. Deliberate practice of a task can be obtained at the appropriate level of difficulty for the individual's level of needed competence. Feedback and opportunities for repetition of those specific tasks helps the learner to achieve competence for that skill. The common expectation is that repetitive practice and appropriate feedback in the

simulation laboratory should show some performance improvement over time. The ultimate goal is to master the skill needed. Deliberate practice is an educational technique used to produce expert performance of the skill needed. In order to gain this expert skill one needs four conditions: 1) intense repetition of the skill itself, 2) assessment of that performance, 3) feedback and finally, 4) show an improved performance in a controlled setting (Ericsson, 2004). Learning from mistakes is regarded as a powerful educational experience and simulation-based training adds value for student learning without causing harm to a patient (Ziv, Ben-David, & Ziv, 2005).

Fidelity is another educational element to improve learning (Brydges, Carnahan, Rose, Rose, & Dubrowski, 2010). With today's high technological advances, high and low-fidelity simulators that mimic closely to humans are useful when simulating skills and both types can have equally positive impacts on learning for students.

When using simulation for learning experiences, use of a simulation specialist to provide technical assistance to the program is also recommended as an evidence-based practice approach (Nehring & Lashley, 2010). The simulation expert adapts the clinical situation according to the student's actions. The simulation expert must have medical knowledge on how a human would respond to certain interventions including medicines and procedures. Not only does the simulation faculty need medical expertise but they also need to be versed on informatics and how to use and troubleshoot the computer systems and high-fidelity mannequins.

### **Synthesis of the Evidence**

Although there were no articles specifically matching anesthesia providers' skills in a simulation laboratory with fiberoptic scopes, there was evidence to support that



methodology of simulation as an evidence-based educational strategy that can positively affect competence and self-confidence of healthcare providers in a variety of skills including airway management. Rowe and Cohen's study (2002) showed simulation was successful in training residents the psychomotor skills necessary to intubate pediatric patients with a fiberoptic scope. After simulation practice, residents who had never practiced FOIs before improved dramatically over the control group which did not use simulation. Kovac et al. (2007) showed that on the most difficult of airways, the fiberoptic adjuncts were more successful at intubation than the bougie device, which was another airway adjunct used sometimes with challenging airways. The literature indicated that simulation was at least as effective at increasing confidence as normal clinical rotations (Baillie & Curzio, 2008; Blum et al., 2010). Goldman and Steinfeldt (2006) revealed all 15 anesthesia residents and four staff physicians improved time to intubate after practicing with a virtual airway simulator. The use of this simulator on cadavers allowed the novice residents to acquire basic FOI skills that were comparable to seasoned anesthesiologists. Additionally, air crew members in Nevada and California found that after simulation training, success rates for intubation and self-confidence levels both increased (Davis et al., 2006). Furthermore, Russo et al. (2007) found after a simulation course, the participants had a significant change on the way they perceived their own skills for accuracy and confidence in evaluation of airways. The combination of lectures, skills stations and scenarios facilitated transfer of knowledge and skills into daily practice.

Additionally, stating clear objectives in simulated scenarios was cited to be important by junior nursing students. Clear objectives and appropriate challenging scenarios

correlated with student satisfaction and self-confidence (Smith & Roehrs, 2009). One article addressed use of lectures and instructor-based medical simulation for difficult airways where most of the attendees for the lecture were experienced airway experts; however, in the opinion of the authors, anesthesiologists could update knowledge about difficult airway management from lectures and demonstrations supplemented with simulation (Chen et al., 2008). Although simulation was found to be effective in many other professions, Cumin et al. (2010) believe that if healthcare would have the same standards for simulation that avionics or the military have, then their confidence in this training technique would be beneficial. Simulation was noted as being used in the medical profession with more frequency. However, human behavior is not as simple to predict as flying an airplane. Healthcare simulations have to incorporate multiple components based on a patient's disease process or medications and incorporation of best educational practices for optimal outcomes.

### **Suggested Practice Change**

Literature espouses the virtues of simulation in its effect on increasing proficiency with skills and self-confidence. However, there was a gap in the literature with skilled anesthesia providers using fiberoptics in a simulation laboratory and increasing their competence and self-confidence levels. Simulation was a valuable teaching method and had been used in many healthcare fields like anesthesia, Intensive Care Units and surgery, as well as in other fields like engineering, aviation, and auto driving. However, the evidence does suggest implementation of a teaching program using simulation to increase nurse anesthetists' skill level and confidence for awake intubations would be appropriate for addressing the identified problem. Incorporating educational principles as

identified in the literature would also support implementation of a training program for FOIs.

**Targeted project outcomes.** Outcomes identified for this project were competence, perceived self-confidence and satisfaction. Becoming competent with a skill usually requires repeated exposure to that specific technique or thought process and this is easily accomplished in a simulated environment (Jeffries, 2007). The first outcome of competence was measured with a timed intubation. Competence or skills performance is one identified outcome of simulation (Jeffries, 2007). Evaluations of competency using simulation have not been rigorously tested for validity or reliability; however, the expectation is that simulation can be used to provide useful information regarding clinical reasoning, and technical skills of individuals. There are many ways to measure competence in the skill of FOI, one of which is the time needed to successfully accomplish the task. The time the scope hits the mucosa, the incorrect placement of the endotracheal tube, injury, and numerous other factors could be measured for competency (time to correctly place the endotracheal tube) but the project director chose time to intubation as the measure for competency for this project. Each nurse anesthetist was timed on two intubations of a normal airway scenario. The first timed FOI was done at the beginning of the course, before the anesthetist listened to the lecture and before they had hands-on simulation training using the fiberoptic scope.

Satisfaction and self-confidence were also used as outcomes significant for simulation scenarios (Jeffries, 2007). Well-designed scenarios help students gain confidence in their skills and can support learning needs of students and promote self-confidence (Jeffries, 2007). Additionally, research has shown that once students are accustomed to simulation

experiences there is an increase in a sense of self-confidence in their psychomotor skills and critical thinking abilities (Jamison, Hovancsek, & Clochesy, 2006).

Operationally, satisfaction and self-confidence were measured using the adapted National League of Nursing (NLN) Student Satisfaction and Self-Confidence in Learning Questionnaire. This questionnaire was originally used for medical-surgical nurses. Approval was given by Dr. Pamela Jeffries and the NLN for use of the questionnaire (Appendices F & G). Additionally, Dr. Jeffries approved the changing of “med-surg” on two of the questions to “airway management”. There were five questions on satisfaction after a simulation program and eight questions on self-confidence after the training. The total questionnaire was a series of 13 self-report statements of the CRNAs toward satisfaction and self-confidence after training.

### **Project Development**

Protocols for awake intubations did not exist prior to this training program. Therefore, three protocols for safe FOI were developed as part of the project with the insight of four airway experts at the military treatment facility. Each anesthesia provider had at least three years’ experience in anesthesia and had used awake FOIs on multiple occasions with success. Each one of the protocols (Appendices J, K & L) used for this project had been used numerous times by the anesthesia providers who developed them. The level of evidence of these three protocols is from authoritative opinions of experts in the field of anesthesia (Melnyk & Fineout-Overholt, 2011).

The protocols were used to develop scenarios using the high-fidelity simulators available in the facility in conjunction with the hospital simulation staff. Together, the project director worked with the simulation staff to set up the location (OR), four

appropriate airway management scenarios which are commonly found in the operating room, set-up the appropriate moulage for each simulation scenario, and set up supplies for the training.

On the day of the training, the protocols were handed out during a didactic lecture along with information on difficult airways and a display of various adjuncts to use in a difficult airway scenarios. The senior anesthesiologist lectured on difficult airways describing how to set up the fiberoptic scope and reviewed various medications to use for awake intubations. These protocols were used as handouts for a didactic lecture using power point that covered equipment, reasons to use FOIs, case studies involving difficult airway management, and the three protocols. Three OR rooms with the mannequins had been set-up earlier in the morning by the project director and the simulation staff. Mannequins were checked and properly functioning. Any airway equipment needed for the simulation was placed in the rooms.

### **Applicability of Practice Change**

Certified Registered Nurse Anesthetists need to be proficient with FOIs, the gold standard for intubation of difficult airways (Agro & Cataldo, 2010). This skill is expected of any anesthesia provider. On any given day in the OR, the CRNA might encounter a patient that needs an awake FOI. This skill must be practiced and the provider must have the competence and confidence in his/her ability to perform the intubation. There is serious risk if the airway cannot be intubated including brain damage or death to the patient. While the program was developed specifically for military CRNAs, outcomes of the project may indicate applicability for all anesthesia providers in any facility.

## **Summary**

A needs assessment identified a problem and made clear that the CRNAs at this medical facility needed and wanted a formal training program for awake FOIs. The problem was that practicing an awake intubation on a human-being would expose a patient to undue harm. Practicing FOIs on mannequins was an ideal training method for the anesthesia providers. The use of high-fidelity simulation in medicine, particularly anesthesia, is gaining momentum and is now a compulsory part of training in many countries (Cumin et al., 2010). There is good evidence to support simulation training using mannequins to improve competence and self-confidence (Baillie & Curzio, 2008; Blum et al., 2010) and there is also support for procedural simulation improving operational performance when using the fiberoptic scope (Davis et al., 2006). Therefore, based on literature, a simulation based training opportunity was developed using an evidence-based educational strategy to increase skills and confidence for anesthesia providers related to FOI.

### **III. Project Implementation**

Step four in Larrabee's (2009) model was to design the practice change. Activities for this step included defining the population of interest, defining the practice setting, identification of resources, ensuring ethical considerations were upheld, and the implementation process for a practice change for training CRNAs on FOI skills.

#### **Population of Interest**

The total population of interest for this project was the 13 military nurse anesthetists at a Midwestern military treatment facility. Each CRNA is a military officer that has a Master's of Science Degree in Nursing and has passed anesthesia boards. The anesthetists work full time and are responsible for preoperative evaluations and a variety of operative cases including obstetrics. The CRNAs work independently and in every surgical specialty. Additionally, these anesthesia providers pull call equally with the anesthesiologists.

This population was selected because the CRNAs are the largest group of anesthesia providers at this facility and expressed a need for FOI skill development. This project had nine available anesthetists on the day of training and all of them participated in the program.

Although the literature review did not indicate evidence addressing the use of FOI by anesthetists, a study by Rowe and Cohen (2002) did show that pediatric residents improved intubation times after simulation training. Additionally, Baillie and Curzio (2008) showed the facilitators of the clinical simulation study thought simulation enabled skills to be repeated which enhanced self-confidence. This project allowed the CRNAs to

practice FOI simulation repeatedly until they felt competent and confident with their skills.

### **Identification of Resources**

Success of the project required identification of appropriate resources. The facility has a simulation center with several high and low-fidelity mannequins. The simulation laboratory is open five days a week and has three trained staff members. Every department in the treatment facility can utilize the simulation laboratory and reserve specialty mannequins as needed for training.

The high-fidelity mannequins can have physiologic attributes similar to actual human-beings. These simulators can talk, have a palpable pulse and heart rate, students can physically auscultate blood pressures, and can have a variety of lung sounds just to name a few of their human-like assets. Additionally, many of the mannequins have the capability to be intubated, to have a central line or intravenous catheter, to have chest tubes, epidurals or spinals placed or even have wounds for practicing dressing changes.

The simulation staff was brought in from the conception of the project. Their availability, advice and willingness to help were essential to the project's success. These stakeholders helped the project director with preparing the simulators for the specific educational program through moulaging the mannequins and getting them physically ready on the day of training.

### **Ethical and Legal Considerations**

Institutional Review Board (IRB) applications were submitted to the medical treatment facility and the affiliated university. There was minimal risk as the anesthesiologists were not practicing on real patients. The risk of time burden to the participants was



eliminated by holding training on a normally scheduled training day. As part of the medical treatment facility IRB application process, specific information was provided regarding proposed costs and time commitments of key personnel. This information was requested in order to receive approval from the IRB as these factors are considered in terms of relevance to the military mission. With the cost of the project noted as minimal (i.e. copying of consents and protocols) and risks to participants minimal, the project was approved as an expedited study by both the military and associated university IRB. One ethical barrier was encountered with the military IRB refusing to approve a written survey that included the participants' demographic characteristics or perceptions of the experience. This was overcome by conducting verbal interviews with participants following the simulation activity. Approval was obtained from the military base and Wright State University (Appendix H). Written agency permission form was also obtained from the military treatment facility.

The consent form for the anesthetists was handed out at the beginning of the training day in accordance with the guidelines from the military's IRB chairperson. The informed consent discussed the purpose of the study, the risks and benefits and right to confidentiality (Appendix I).

Maintaining confidentiality and anonymity were of utmost importance. Participants were told that data would only be presented in aggregate form and no demographic data were collected thus aiding with confidentiality of the participants. The participants chose a word or phrase that would be recognized only by them and placed on the front of an envelope. When the anesthetists did the first timed FOI, they placed the score on the index card in their envelope. The senior anesthesiologist confirmed the score that was

placed on the card. After the CRNAs had the advanced airway lecture and practiced on the four different airways on the mannequins, they were tested again on the time for a successful intubation. The envelopes were collected at the end of the training by the senior anesthesiologist. The post-training questionnaire used to evaluate self-confidence and satisfaction was done anonymously with no identifiers. The confidentiality of the participants was maintained.

Practicing an awake intubation on a patient for simply the “experience” was ethically questionable (Ziv, Wolpe, Small & Glick, 2003). According the principle of nonmaleficence, a person should not inflict harm that includes emotional or physical injury to another person (Beauchamp & Childress, 2001). Ziv et al. (2003) proposes performing any invasive procedure on patients without first practicing the skill in a simulation laboratory was unethical. The simulation event allowed providers to practice this crucial skill with no harm to a real human being.

### **Process for Implementation**

Coordination with simulation staff for the project was done two years in advance of the actual training. The simulation staff were able to moulage the mannequins with various types of airways. The staff worked on secretions for the mouth and wounds to the face. The four different airways chosen for the anesthesiologists to practice on using moulaged mannequins were: 1) normal, 2) swollen tongue, 3) normal airway progressing into a laryngospasm and 4) knife (foreign object) in the oral pharynx along with bloody secretions. These particular airways offered a variety of abnormality to the oropharynx that is often seen when intubating patients in the operating room or trauma setting.

There are multiple ways to intubate an awake patient using a fiberoptic scope. However, some methods are not as good as others. The patient needs to be awake, but comfortable, breathing on his own, able to talk to the providers and the airway needs to be protected. With awake intubations the patient remains breathing during the procedure, thus ensuring a safe outcome for the patient. However, written guidance is limited; therefore, three protocols were developed for the training program. These protocols for awake intubations for this project were developed by airway experts known for positive outcomes with awake intubations. Three anesthesiologists and one CRNA from the military treatment facility were interviewed for their techniques with these types of intubations. The protocols were then written and reviewed by another experienced anesthesiologist to ensure wording and safety measures were correct (Appendices J, K, & L).

After the IRB approval was obtained by the military facility and affiliated university, a date was set for the training. The vacant OR rooms that day were set aside for the training. The OR manager was kept informed and aware of the training that was to take place in those rooms.

On the scheduled monthly training day the informed consents were signed and questions answered by the project director. Clear objectives for the day's events were verbalized to the participants. The CRNAs who agreed to participate in the project were timed on a FOI using a high-fidelity simulator with a normal airway by the senior anesthesiologist. One room was used specifically for the timed intubations. In this OR, the mannequin was set up with the FOI equipment, the anesthesia machine and the necessary equipment for an awake FOI. The only people in the room were the

participating CRNA and the person who timed the intubations, the senior anesthesiologist. With each of the two timed intubations, the senior anesthesiologist gave the CRNAs a brief difficult airway scenario and then timed each CRNA from start of picking up the scope to the successful finish of intubation with the ETT going through the vocal cords and hooking up the breathing circuit. The scenario was that of a patient lying supine on the OR table with the patient requiring a FOI because of a history of a difficult intubation. This particular mannequin had a normal airway and the anesthetist could see the airway without any unusual obstruction. The scope machinery was already at the bedside and prepared for the intubation. The same scenario was given to each anesthetist for each intubation. The stop watch was started when the anesthetist took the fiberoptic scope and the clock was stopped after successful intubation and hook up of the ventilator to the ETT. The anesthetists practiced as many times as they wanted before they were timed again. On their second timed intubation, the exact scenario and starting and stopping points were used for the timed event as before the training. Both timed scores were placed on the individual's index cards and placed in their confidential envelope that was then given to the senior anesthesiologist who acted as time keeper.

After the initial timed intubation, the staff met in the anesthesia conference room in their work area where the lead anesthesiologist provided a didactic lecture on the scope, difficult airway management and the three protocols for an awake FOI facilitated by power point. This lecture lasts approximately one hour. Hand-outs on the protocols were given at this time.

After the airway and fiberoptic scope didactic presentation, the CRNAs moved to any one of the operating suites to go over these intubations on the mannequins. Practicing the

intubation skill was important to accomplish in as close to real settings as the events occur. The senior anesthesiologist was in one room and directed the CRNAs through the checklists, scenarios and various protocols. The project director was also available to guide the participants through various airway types with the fiberoptic scope.

There were three operating suites and four mannequins all day for the CRNAs to practice FOIs skills. One station was a high-fidelity mannequin with a normal airway. This is the station the anesthesiologist used for the timed intubations. When the mannequin was not used for the timing portions of the project, the room was open for practice. Another station had a mannequin who started with a normal airway but then developed a laryngospasm. The computer program that allowed the vocal cords to close was run by the simulation coordinator. The anesthesiologists were able to visualize the throat swelling. Additionally, another room had two mannequins; one with a swollen tongue, and the other with a traumatic injury to the face and secretions in the back of the pharynx. These last two rooms did not require any computer simulation programs, thus no additional staff was needed in order for the CRNAs to practice on those airways.

The anesthesiologists practiced as often as they wanted on these mannequins. Experts in the field of anesthesia estimate that 60 simulated or real fiberoptic intubations to be the key number to target in order to be proficient at this advanced airway skill (Hung & Murphy, 2008). Although the amount of times each anesthesiologist practiced was not counted, by the end of the training all participants had the opportunity to use the fiberoptic scope 50-60 times. When the anesthesiologists felt comfortable and ready for the second timed intubation, they found the senior anesthesiologist and went back into the same room with the same mannequin and scenario and were timed on their second FOI.

After the CRNA was done with his/her second timed intubation, the project director was outside the room and gave each participant the adapted NLN questionnaire evaluating self-confidence and satisfaction. Every participant filled out the form immediately and put the paper in a pile outside one of the OR rooms. Informal participant responses regarding the experience were also gathered. The entire training lasted about four hours.

Since the literature states the importance of debriefing in any simulation training experience, the use of debriefing and answering of questions was conducted with each participant individually during and after the experience. The project director and senior anesthesiologist spent time in each room discussing various techniques and giving continual feedback to the students. Additionally, peers helped each other with past experiences and methods that had worked for them. Feedback regarding better techniques, different medications or how to adapt regimen for various patients was continuous throughout the practice time. Students were allowed and encouraged to discuss techniques and voice questions about anything of concern.

### **Summary**

A simulation training program was developed and provided to nine nurse anesthetists who were trained and timed on two FOIs, before and after training. The entire training and hands-on practice occurred in the actual setting where they would realistically use this skill. Outcomes of satisfaction and self-confidence were also assessed. Project evaluation is discussed in detail in the next chapter.

#### **IV. Project Evaluation Plan**

This chapter reviews the evaluation of the process and impact of a FOI training program on competence, self-confidence and satisfaction for the CRNAs.

##### **Evaluation of Implementation**

The project director went from room to room during the training, answering any questions from the participants. The ORs were in close proximity to each other and the project director could move easily to each room to watch and evaluate implementation.

The adapted NLN questionnaire on Student Satisfaction and Self-Confidence in Learning was given and collected from the 9 anesthetists after their final timed intubation; thus, at the end of the training. Results from the satisfaction subscale were used to assess how CRNAs perceived the implementation of training.

##### **Evaluation of Impact**

Impact was evaluated by assessing three outcomes of competence, self-confidence (the feeling of increased autonomy and independence), and satisfaction. These outcome measures provided the answer to the original PICOT question: Among licensed nurse anesthetists (P), how does completion of a high-fidelity simulation training program for fiberoptic intubations (I) as compared to before completion (C) affect short term level of self-confidence and competency with performance of the skill (O) following program completion (T)?

**Competence.** For this scholarly project, competence was measured based on timed intubation of a normal airway given in the form of mm:ss.ss (minutes, seconds, milliseconds). The statistician converted that to seconds with hundredths of seconds. That is, instead of 1:40.81, she converted the numbers to 100.81. That made the

calculations easier for SPSS (a statistical package designed to perform a wide range of statistical procedures) to handle.

In order to determine if training on high-fidelity simulators with a fiberoptic scope affected competence, timed intubations before the lecture and hands-on practice occurred and then once again after the training was accomplished. The difference between each CRNAs score was used to determine if the training helped to improve their time to intubation or if the training had no effect on their intubation skills (competence). For this quantitative timed intubation data analysis, SPSS was used for analysis of differences pre and post training using a paired t-test.

**Self-confidence.** At the end of the training each anesthetist was given the 13 item adapted NLN Student Satisfaction and Self-Confidence in Learning questionnaire. The NLN questionnaire was used to evaluate both self-confidence and satisfaction of the CRNAs and has 13 questions on the form using a five-point Likert score with “1” being “strongly disagree with statement” and “5” being “strongly agree with statement”. This instrument was chosen because of its reliability and validity. This questionnaire has a reported Cronbachs alpha score of 0.87 for the self-confidence subscale which has eight items ([http://www.nln.org/researchgrants/nln\\_laerdal/instruments.htm](http://www.nln.org/researchgrants/nln_laerdal/instruments.htm)). This instrument was developed specifically for post-training evaluation; therefore, was only given to participants following the simulation training. SPSS was used to analyze the minimum score, maximum score, mean and standard deviation (S.D.) from response of this questionnaire. This questionnaire was given after the simulation experience to discern perceived self-confidence for this skill after the training.



**Satisfaction.** Satisfaction with the training program was also evaluated using the satisfaction subscale of the adapted NLN questionnaire. The questionnaire has a Cronbachs alpha score of 0.94 for the satisfaction subscale and has five items ([http://www.nln.org/researchgrants/nln\\_laerdal/instruments.htm](http://www.nln.org/researchgrants/nln_laerdal/instruments.htm)). SPSS was also used for this descriptive statistical analysis. Additionally, comments from informal surveys from participants were gathered after completion of the training experience and were helpful to the project director in evaluating the satisfaction with the program.

### **Summary**

The evaluation plan of the project focused on the implementation process and outcomes of competence, self-confidence and satisfaction. These three outcome evaluation measures were assessed by use of the timed intubations, the adapted NLN questionnaire and informal comments from the participants at the end of the program. The paired t-test was used to discern the difference between the first timed intubation and the second timed intubation which occurred after the training in order to determine if a significant difference in competence could be identified after the training. The NLN tool was chosen for outcomes of self-confidence and satisfaction with the program because of its identified reliability and validity. Findings from these evaluation measures are discussed in the next chapter.

## **V. Project Findings**

This chapter presents the findings of the FOI simulation project. The significance of these findings in terms of practice, research, and education are discussed.

Recommendations for future projects are also presented.

### **Description of Participants**

There were nine board certified registered nurse anesthetists who participated in this project, which represented every CRNA present on the day of the training. While all held master's degrees in nursing, none of the CRNAs had doctorate degrees. No demographic data were collected due to the small number of participants and the ability therefore, for the data to be kept confidential as required by the IRB. While there were a total of 13 CRNAs, only nine CRNAs/military officers completed the training program for FOIs on four different high and low fidelity simulators. The other four anesthetists were not able to participate because they were either on leave or post-call.

### **Findings Related to Process**

The one day training program for this project lasted from 0800 until 1200 on the regularly scheduled facility training day in September. There were no time constraints since no cases were scheduled as was the practice for training days. The entire anesthesia staff (total of 29 CRNAs, CRNA students and anesthesiologists) participated in practicing with the equipment; however, the CRNAs were the only providers who participated in evaluation of this project. Each of the three operating suites was full of CRNAs and anesthesiologists practicing, offering advice and learning from each other; the CRNAs were actively involved in the learning experience. The three ORs used for the experience were in close proximity to each other and the project director could move easily from

room to room to watch, answer questions and evaluate implementation. The use of high-fidelity, life-like mannequins and the ability to work in an actual OR helped with the reality of the simulation training.

The project director and the simulation staff spent two hours setting up and two hours cleaning the mannequins and the ORs after the project. Moving the machines and mannequins from the simulation laboratory to the OR to achieve better reality to the program was time consuming and labor intensive. Additional time was used to moulage the mannequins the week prior to the experience. Future projects would need to consider the amount of time required for set up for such a simulation experience especially in relation to the number of sessions or times a class is repeated, the number of participants and the blocks of time needed for the practice of the skills.

### **Findings Related to Impact**

The three outcomes of competence, confidence, and learner satisfaction were measured to assess impact of the project. The nine nurse anesthetists who participated in the educational training program were evaluated through timed intubation competence assessments and completion of the adapted NLN questionnaire for Student Satisfaction and Self-Confidence in Learning.

**Competence.** For the evaluation of competence in FOI, participants were timed before and after training using the same scenario (normal airway with history of difficult intubation) and the same mannequin. The fastest time to intubation before training was 19.66 seconds and the longest was 232.37 seconds. The mean time was 83.42 seconds (S.D. 67.68) and the median was 59.24 seconds.

Following training, the time to successful intubation scores ranged from 13.22 seconds to 99.19 seconds. This is a huge improvement when time is of the essence. In addition, the mean dropped to 30.55 seconds (S.D. 26.165) and the median fell to 24.38 seconds.

The mean difference between pre-training and post-training was 52.87 seconds and the median score decreased by 34.86 seconds. By looking at the individual scores and taking the difference between pre-training and post-training, the data show that while mean time decreased, one CRNA actually had an increased time of .91 seconds. While the time to intubation did increase from pre to post training for this participant, the difference was less than one second with both pre and post training scores well below the group mean. Each of the other CRNAs decreased their time and three of the nine decreased their time by more than one full minute. A paired t-test was done to determine if there was a significant difference in timed intubations pre and post training. Based on the t-test, there was a significant decrease in timed intubation after training ( $t= 3.365$ ,  $p= 0.01$ ), thus an improvement in competence with successful intubation using the fiberoptic scope.

**Self-confidence.** The second outcome measured was self-confidence in ability to place a FOI after the course. To measure this outcome, the self-confidence subscale of the NLN Student Satisfaction and Self-Confidence in Learning was used. The Self-confidence subscale consisted of eight items, each rated one through five using a five-point Likert scale. The eight items on the Self-confidence subscale scores could range from “1” (low self-confidence) to “5” (high self-confidence). The total possible range for the subscale was 8 to 40. For the nine CRNAs, there was almost no variation. The CRNAs scores ranged from 34 to 38 with a mean of 35.67 (S.D. 1.118) and a median

score of 36. The results indicate the nine subjects had a high level of self-confidence in the ability to perform the FOI skill after this training.

**Satisfaction.** The satisfaction subscale of this NLN Student Satisfaction and Self-Confidence in Learning was used to determine participant's satisfaction with the training program. Like the self-confidence subscale, the satisfaction subscale also used the same five-point Likert scale and consisted of five questions. The total possible range for the subscale is 5 to 25. For the nine anesthetists, there was almost no variation. Results for satisfaction with learning on all questions were fours or fives on the five-point Likert scale indicating overall, the nine subjects were very satisfied with the training. The lowest participant score was 24 and the highest was 25. The mean was 24.78 (S.D. 0.441) and the median score was 25 indicating the students were satisfied with the training.

Informal surveys were done after the training by the project director. The nurse anesthetists frequently commented on the benefits of the program with comments, "We need to do this more often, this was a fantastic learning experience" and "This was great way to learn how to practice FOIs". Every informal comment from the CRNAs was positive with no weaknesses provided by any of the participants.

### **Desired Project Outcomes**

The desired outcomes were: 1) an improvement in timed intubation meaning the time to accomplish a FOI decreased after practice or indicating competence with the skill, 2) a high self-reported level of confidence with the awake FOI technique after the training and, 3) a high level of self-reported satisfaction with the training program. All three of these outcome measures indicated positive results. There was a significant decrease in

timed intubations from the first to the second FOI. The decrease showed that the simulated FOI training was effective in terms of competence specific to this skill. Additionally, the results from the adapted NLN questionnaire showed that both satisfaction in the training and self-reported confidence were high after the training. The overall goal of the project was to improve FOI when confronted with a difficult airway. Although no actual patients were used for this project, improvement on time to place the ETT should carry over into the real world environment when a difficult intubation is encountered by improving competence and self-confidence in performing the procedure.

### **Factors Facilitating Outcome Achievement**

Early involvement with the stakeholders (the CRNAs) was essential in making this project a success. These key stakeholders had input from the beginning starting with the identification of a problem through the needs assessment. Additionally, the value-added practice time in the actual environment in which these skills are practiced was important. The entire training time was used productively; the time spent was not wasted. CRNAs moved from room to room as they desired. Staff did not have to come in during their day off or during lunch in order to receive training. Additionally, the questionnaires used to measure outcomes were not time consuming taking the participants less than five minutes to complete. Completing lengthy and time-consuming questionnaires can increase dropout rates in studies (Hoerger, 2010). Results showed that 10% of participants drop out instantaneously with the onset of a questionnaire and an additional 2% of participants quit with every 100 questions in a survey. Many informal comments from the CRNA participants about questionnaires and surveys taking too much time were an impetus to find a reliable and valid questionnaire that was not going to require a lengthy amount of

time to complete for this project, which in this case took participants less than five minutes to complete.

The senior anesthesiologist was another key stakeholder. His support in developing protocols and assisting with the training was needed for success. When asked for feedback and future recommendations, the senior anesthesiologist had no other input stating, “This seemed to work out perfectly, I cannot think of a way to improve on the program. The anesthesia staff was very engaged and interested in learning.”

The success of the project was also facilitated by the incorporation of teaching learning principles. By using the high-fidelity simulators, the project director applied strategies to address a variety of types of learners. Simulation incorporates all three learning styles (visual, auditory and tactile or kinesthetic) (Jeffries, 2007). This was accomplished by watching others use the FOI equipment, by listening to the lecture and viewing the power point presentation by the senior anesthesiologist, and by active participation with hands-on experience using the equipment for intubating the mannequins. Each anesthetist was able to listen to the advanced airway lecture, observe several methods for intubating with a fiberoptic scope and actually use the equipment and mannequins for practice with the new learned techniques.

In addition, the education principle of treating the students as adult learners appears to have been successful in developing perceived self-confidence in FOI. In order to achieve self-confidence some key variables need to be addressed which can include ensuring the education program covers critical content, considering needs of diverse learners, and providing active participation to enhance critical thinking and the repetition of skills (Billings & Halstead, 2005; Bryan et al., 2009). Content of the program was specific to

critical skills needed for the awake intubations. The difficult airway lecture and the protocols specifically designed for awake intubations were discussed on the training day.

Each CRNA has their own way of intubating a patient with a difficult airway and this educational approach allowed them the diversity to practice incorporating feedback and group thoughts on how to improve their own technique using standardized checklists.

The active participation of each CRNA was evident by watching them use each scope and practice on every mannequin. Each of the three ORs was full of activity and active discussions.

In this training program, the CRNAs knew why they were learning and expressed the need for training. They were motivated to solve the difficult intubation dilemma that each one could face on a daily basis, they used previous experiences and built on those skills and finally, they were given the protocols for awake FOIs to use for their individual practice.

The project also implemented the key educational principle of deliberate practice or repetition in honing in this advanced airway technical skill and improving competence. Deliberate practice and repetition has been described as important for learning and development of simulation experiences (Jeffries, 2007). Lower order skills competencies can be taught with traditional classroom settings. Higher order skills competencies, such as fiberoptically intubating a patient, are more difficult to acquire and simulation scenarios can be designed to accomplish these more critical, higher cognitive skills using deliberate practice (Turcato et al., 2008). Simulation is not new to education; however, new technology can now closely replicate human anatomy and behavior in a realistic manner and used to experience what may happen in real world scenarios. This



simulation program afforded the adult learners experience to practice critical skills that are not readily acquired in every day clinical practice repeatedly with supervision. The experience offered a learning opportunity that is not possible by reading or sitting in a lecture; the CRNAs practiced a high risk, low volume skill set that is mandated by their profession (ASA 2003; Hung & Murphy, 2008; Weiss & Deutschman, 2000).

Having the evidence-based project occur in an actual OR on a regularly scheduled training day added to the success of the project. In addition, using the operating suites facilitated the fidelity of the training program. The simulation specialist worked with the computer controlling the mannequins to show the providers how the tongue can swell and the throat can close up while they were actually viewing the airway and trying to place the endotracheal tube with the scope. The CRNAs could repeat the task as many times as they wanted, and were allowed to reflect on their performances and get advice, support and formative feedback from peers as they were doing the intubations.

### **Challenges and Barriers**

There were a few challenges and limitations that needed to be addressed in order to successfully complete the project. The first challenge was the Institutional Review Board at the medical facility denying the use of formal surveys for the participating CRNAs to address demographic characteristics and perceptions of the training experience. Due to the numerous research requests to survey military members, stringent guidelines have been developed that require high level approval for any use of surveys given to military members and could not be approved by the local IRB. However, informal replies from the anesthesiologists and personal observations by the project director regarding the training could be used for an informal evaluation of the program to overcome this barrier.

The second challenge was the limited time of these providers for additional training. The anesthesiologists did not want to stay after work or come in on a day off to train. This barrier was eliminated when the simulation program was done on a scheduled training day that the hospital administration had already deemed as a day off from OR cases so staff could train.

Cost of simulation can be another barrier or limitation to educational programs and high-fidelity simulation equipment requires a significant financial investment and extensive faculty involvement (Gaba & Raemer, 2007). The actual cost will depend on how often the course is offered. At this organization, the program should be provided once every two years to meet military training requirements; however, similar courses can be taught more frequently because all of the on-site simulation laboratory and the high-fidelity mannequins are already purchased. While money was not a barrier for this specific project, it would need to be addressed in other facilities without the resources of the hospital used. Each facility will have to address if the cost for a simulation lab and if the time spent to train will be worth the money in order to help with educational gaps and skills of their providers. Hospital administrators must be able to address if the cost of time off for skills training outweigh the risk of potential litigation if an adverse event occurs.

Another barrier was the paucity of tools to measure the outcomes of satisfaction and self-confidence. The instrument used in this project was the adapted NLN Student Satisfaction and Self-Confidence in Learning questionnaire, which has strong evidence of reliability and validity. However, one limitation is that this questionnaire is a self-report instrument. Self-assessment is one method to describe the learners thought process.

However, there is community discussion pertaining to whether people are able to accurately self-assess. While learner perceptions can be useful in determining if simulation was appropriate, there is evidence that self-reports of participants may not predict their actual levels of task performance in clinical settings (Eva & Regehr, 2008). Therefore, while high levels of self-confidence were reported by participants, it is possible that perceived performance improvement may not actually enhance clinical performance. Some participants may have an overinflated sense of self-confidence with the task and stop practicing because they believe they have achieved competency (LeBlanc, 2012). This self-confidence can be troublesome when the trainees' confidence and perceived abilities exceed their true abilities. In addition, this instrument is designed for post training use only and was originally developed for use with non-licensed professionals; therefore, results are limited because of the lack of comparison for the outcomes of satisfaction and self-confidence and inability to know if adaptations made for licensed anesthesia providers affected outcomes.

Finally, the outcome of competency was limited by measurement of timed intubation of a normal airway. There are a plethora of reasons that a FOI may need to be used to address difficult airways such as obesity, cervical stenosis, and trauma that were not assessed in this project. Future projects could utilize any number of these airways during simulation scenarios for practice in skill competencies.

### **Clinical Significance**

Ever since the Institute of Medicines (1999) report found 44,000 to 98,000 people die in hospitals each year as a result of medical errors, patient safety and medical errors have been thrust to the forefront of healthcare (Kohn, Corrigan, & Donaldson, 1999). This

report spurred the healthcare community to put millions of dollars into improving patient safety (Forster, Dervin, Martin, & Papp, 2012). Additionally, Medicare and Medicaid Services may no longer reimburse for treatment required due to a preventable human error and these malpractice cases and costs would likely fall on the providers or the institution (Ford et al., 2010). A simulated environment allows for relevant learning and immediate feedback, both necessary for clinical skill development. What makes simulation so powerful is that skills can be taught that may not normally be available through clinical rotations. Additionally, participants can manage the tasks and make mistakes without any harm to a patient or the provider. Therefore, simulation-based educational training for medical professionals may be an avenue for healthcare organizations to pursue to increase patient safety, especially for high risk, low volume skills such as FOI and other airway management skills. In the case of FOI, the clinical significance is pertinent in terms of effects of inadequate oxygenation. Brain cells are destroyed after four to six minutes without oxygen

([http://www.ehow.com/about\\_5506985\\_long-can-brain-survive-oxygen.html](http://www.ehow.com/about_5506985_long-can-brain-survive-oxygen.html)). Lack of oxygen to the brain can result in a patient being in a vegetative state where bodily functions may exist, but the patient is unresponsive or lack of oxygen can lead to death. Therefore, not only is the decrease in timed intubations statistically significant, but it is also clinically significant for a patient as well as a patients' family/significant others.

A main limitation or barrier to simulation is that the educational value is learner dependent. Simulation requires the student to be fully engaged in their own educational process. All-in participation is necessary if the student is to gain competence with the intended scenario and task. A lack of engagement in a simulated scenario may also stem

from lack of leadership involvement. Each participant, along with the organizational culture, must be motivated to change and use the simulation tools available to gain self-confidence in skills and ultimately improve patient safety.

The successful outcomes of simulation-based fiberoptic scope training program for nurse anesthetists as seen in this project reflects findings from prior research related to the use of simulation for airway management (Blum et al., 2010; Goldman& Steinfeldt, 2006; Kovac et al., 2007). In addition, this project is consistent with earlier research findings of studies with positive self-reports of confidence and satisfaction after a simulator aided airway course (Baillie & Curzio, 2008; Davis et al., 2006; Russo et al., 2007). Scientific underpinnings of an EBP model and educational principles related to simulation were used to design a practice change. The education principles used for this simulation project helped increase the knowledge base of the participants and skills. Much thought was put on how to deliver and teach the skills. The combination of didactic training and hands-on skills in as close to a real environment as possible made the training dynamic and optimal for learning.

This project was able to demonstrate that an evidence-based training program for anesthesia providers using simulation can lead to positive outcomes in terms of competence, self-confidence and satisfaction. For the first time the CRNAs at this facility have standardized protocols and training process for an important high risk, low volume skill. This training offers anesthetists the opportunity to be more skilled at FOIs thus improving provider competence and patient safety for this must-have skill for nurse anesthetists. The project director advocated for better training programs for CRNAs who are essential members of the anesthesia team. Policies have now been put into place to

change training for these practitioners at this facility and this program has been shared with similar facilities throughout the Air Force medical system.

### **Implications and Recommendations for Future**

**Practice.** This project has resulted in a change in practice for training anesthesia providers in this facility. Having a formalized teaching outline and materials that are readily reproducible is necessary for the sustainability of this program (Appendix M). Larrabee's six step model provided key attributes for success to the design. Evidence indicated that a new practice is more likely to be adopted if five benefits were met: there is an advantage to the new program, there are perceived benefits by the staff, training is simple and is augmented by current technology, and finally, there is a good system fit between skill and benefit of that skill to the provider (Larrabee, 2009). The CRNAs are likely to sustain this new training practice since all five criteria were met with this program.

This new change in practice fits into this military organization, in part, because the simulation laboratory was on site and available five days a week. Additionally, the participants were the ones who identified the need for a program to practice this specific skill and the anesthetist's were satisfied with the initial training offered on an already scheduled hospital day of training. The success of the project can now be used to develop programs that are standardized military system-wide for anesthetists so that each facility does not have to develop their own protocol for meeting required military competencies related to airway management. Anesthesia providers will know what to expect and be comfortable in knowing that the training and resources will be available no matter what military hospital they are assigned.

The protocols are similar to checklists. Many professions use checklists to ensure safe operating procedures. Checklists are step by step objective tools used for quality improvement and safety (Harmon et al., 2013). Anesthesia uses checklists for their anesthesia machines every day before starting cases and pilots go through a detailed checklist before they are allowed to fly the airplane (Alinier et al., 2006). These three new FOI protocols, or step by step checklists, were developed by seasoned anesthesia providers using techniques that have worked successfully in the past. The protocols, while based on lowest level of evidence (expert opinions) provide a consistent standard for performing FOI. Further work is needed to validate these checklists through research that could lead to development of practice guidelines for this skill.

However, the success of a practice change in other systems will require addressing issues that facilitated the success of this project. Having an appropriate level of simulation equipment and a simulation expert who understands the principles of simulation and expenses for buying and maintaining both high and low-fidelity simulator is also recommended and a key success factor for this project. The simulation expert can guide the educator in using the computer programs for the mannequins as well as assist in developing scenarios and handbooks for the simulation. While the resources for simulation experts was available in the facility for this project, obtaining funding for the equipment and personnel resources may be a barrier for implementing similar projects in organizations without this support. A start-up cost estimate for the initial set up of a simulation can be expensive and upwards of \$292,000 with the bulk of the money (66%) going to on-site construction (Weinstock et al., 2005).

In addition, non-military settings will need to address the costs of paying anesthesia providers to receive training and not generate revenue for operating room cases. The military facility for this project has determined the need for monthly training but this does not affect the budget of the facility as it would a civilian facility that would need to continue to pay anesthesiologists hourly rates of \$40 to 120 for unbillable activities (Ackley, 2013). While the costs for the resources are not inexpensive, healthcare organizations must consider the value added from the use of simulation-based training on preventing adverse events and promoting positive outcomes with this risk-free type of training. In order to sustain a new training program, it has to be adaptable to the personnel and the simulation capabilities of the medical center. The best use of simulation will depend on a clear understanding of what can and cannot be accomplished with the mannequins and their various capabilities for each facility. Although not addressed in this paper, future projects could address other possible outcomes such as number of hypoxic events, pain during FOI or damage to the airway itself.

**Research and scholarly development.** While the currently available evidence was limited in terms of the use of simulation training for CRNAs and FOI skill training, the evidence did suggest that high-fidelity simulation is an evidence-based learning strategy with positive outcomes (Crabtree et al., 2008). The realism of simulation training allows for virtually every skill to be rehearsed by healthcare professionals to promote patient safety (ASA, 2003; Issenberg & Scalese, 2008; Nishisaki et al., 2007). This project was able to demonstrate that an evidence-based teaching strategy, simulation, can be successfully used to produce positive outcomes specifically for CRNAs in terms of FOI airway management skills in terms of competence, self-confidence, and satisfaction. For



the strongest link from simulation practice to real-world impact validation, future research projects should examine if participants actually had a real world patient who needed an awake FOI and determine if the training helped with the skill and self-confidence of the provider. Information on how long after the simulation training took place until the actual FOI on an actual patient event would also be interesting to note. Future research studies examining transfer of what is learned with simulation into actual clinical performance, and actual patient outcomes is needed to enhance the evidence related to the use of simulation for healthcare (Aggarwal et al., 2010). Therefore, research examining if a simulation experience carries over to competency in real world events is unknown and merits consideration. By following the CRNAs who participated in this class for several years, a longitudinal research study could be designed to see if real-world awake FOIs were successful measured by consistent times to intubation as those measured immediately after the simulation. Additionally, this project used “normal” airways. In future studies, more difficult airways could be used to study competence and time to intubation.

Nurse anesthetists are expected to intubate difficult airways with a fiberoptic scope. Concerns regarding how often this training should occur to prevent skill decay are an issue with no absolute parameters. In a systematic review of retention of adult advanced life support skills in healthcare providers, the authors found out of 336 articles and 11 papers reviewed that variable rates of knowledge or skills deteriorated over six months to two years after training (Yang et al., 2012). Additionally, evidence suggested that skills are lost faster than knowledge. Issues related to the appropriate amount of frequency to train for maintaining the FOI skill warrants further studies.

In addition, further research is needed with more rigorous designs to determine change in skills pre and post-training using valid and reliable instruments to document outcomes. In this study, the instrument available to assess outcomes of satisfaction and self-confidence was developed for a post-test design only. Further development of instruments that can provide stronger evidence of a simulation training pre to post training will help build the evidence supporting the use of simulation.

**Education.** Simulation allows not only the opportunity for practice on a skill but also allows the student to think through complex issues and verbalize with the patient and other staff members. There is growing evidence that simulation accelerates the speed and the quality of learning by the student and may significantly decrease medical errors (Turcato et al., 2008). High-fidelity simulation training allows students to learn in realistic, operational conditions. The growing acceptance of simulation in training is attributed to shorter hospital patient stays that has led to reduced access to practice on patients and the growth of technology which allows life-like mannequins to be used for virtually every skill set for the healthcare workers to use to achieve clinical skills to promote patient safety (Issenberg & Scalese, 2008).

This project implemented principles of adult learning as well as recommendations for the use of simulation in healthcare training to develop and implement the CRNA training program for FOI skills that was evaluated on the outcomes of self-confidence, competence, and satisfaction. Future projects may want to incorporate more emphasis on talking to the patient. This study did not emphasize the anesthetists verbally telling the patient/mannequin what was going to happen. Invasive procedures require not only psychomotor skills but also patient interaction. A comprehensive approach to clinical

safety intertwines the hands-on skills along with the psychosocial and communication aspects of patient care (Finkelman & Kenner, 2007).

Additionally, the use of video recording along with the expert feedback could be evaluated for using in this type of simulation experience. The CRNAs can watch themselves during the FOI because one can pick up on lapses in techniques or may notice if they are not telling the patient what is about to happen. While literature suggests the use of video-recordings are effective in assessing competencies and improving skills (Brimble, 2008; Lane & Gottlieb, 2004; Minardi, & Ritter, 1999), the use of these recordings is not known with a FOI skill training program but may be a significant component for enhancing the acquisition of this skill.

This four hour training program included a lecture, hand-outs and hands-on participation. Offering this training as part of orientation and provision of continuing education credits for this course would be useful to the providers. The military facility has an education department that can assist in obtaining the necessary paperwork in order to provide the educational benefits for the providers and this could be added to future classes.

As technology continues to evolve, educational forums that address the critical need for improving healthcare provider competencies and patient safety must be examined for evidence suggesting their feasibility. Long gone are the days where a chalkboard and overhead projectors are used for student learning. Students today become easily bored unless using the latest technological devices. Currently, high tech simulation mannequins promote hands-on, fully engaging clinical skill-set training. In addition, many of today's learners are able to attend classes in the virtual world with their own avatars and

communicate with the other cyber students and professors around the globe. This Second Life or virtual world is another dimension to simulation that allows for real time dialogue between the students and the professor (Skiba, 2009). Games and virtual world simulations can provide educators with the opportunity to engage students in an interactive environment where higher levels of reasoning and critical thinking are necessary. Evidence exists that virtual reality technology does provide positive outcomes for skill competency for such skills as airway management (Goldman & Steinfeldt, 2006). Technologies such as virtual reality may provide even more realistic training for high risk, low volume skills such as FOI in the future as this type of technology continues to evolve. Keeping up with the latest information technology is essential in order to offer healthcare providers the most effective means to ensuring patient safety and quality of care.

## **Conclusion**

Historically, difficult intubations have been a true anesthesia crisis. Without the ability to successfully secure the airway the surgical patient is at risk for morbid deficit outcomes from oxygen deprivation up to and including death. This is a significant patient safety situation. The recent Institute of Medicine reports highlight the importance of improving patient safety in healthcare through the use of technologies to teach and assess competency (Finkelman & Kenner, 2007; IOM, 2011). This new simulation teaching program offered the opportunity for CRNAs to safely practice this clinical skill utilizing the latest technologies and programs to educate anesthesia providers using high-fidelity simulation. This skill benefits the patient(s), the practitioner, the hospital and the

community ultimately providing critical airway management and improving patient safety.

This training program is a completely new paradigm for consistently teaching FOI skills for anesthesia providers. Not only is it now a standardized educational training program with written protocols that can be replicated by any anesthesia provider, it is also a revolutionary modality to train anesthesiologists this must have, critical skill set for improving patient safety.

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## Appendix A

### Needs Assessment Survey

Departmental Needs Assessment:

(Eight surveys returned)

1. When was the last time you **trained** using a fiberoptic intubation scope?  
*-answers ranged from 2 months to over 15 years ago with one stating, "No formal training since school"*
2. When was the last time you used the fiberoptic scope on a patient?  
*-100% had used a fiberoptic scope within the last two years on a patient*
3. How many times have you used the fiberoptic scope on either an anticipated or unanticipated difficult airway in the last five years?  
  
*-twice.....1 anesthetist (12.5%)*  
*-three –four times.....3 anesthetists (37.5%)*  
*-five – seven times.....3 anesthetists (37.5%)*  
*-over 30 times.....1 anesthetist (12.5%)*
4. Would you like simulation experience with fiberoptic scopes?  
*-yes (100%)*
5. Are there any other airway skills that are high risk yet low volume that you would like training on?  
*-emergent cricothyrotomy...3 anesthetists (37.5%)*
6. When would be the best time for training in the simulation lab?  
*-100% said training days*
7. Would you like any other materials to help with training on fiberoptic intubations?
  - 3 requested hand-outs (37.5%)
  - 1 said, "The more hands-on training, the better" (12.5%)

## Appendix B

### Databases Searched and Data Abstraction CINAHL Searches

Date of Search	Keyword Used	Database/ Source Used (CINAHL, PubMed & Cochrane)	# of Hits			Rating System/Author
			Listed	Reviewed	Used	
26 Jan 11 #1	fiberoptic intubation, simulation	CINAHL	2	2	1 Excluded LMA devices	Level VI/ Goldmann
26 Jan 11 #2	fiberoptic intubation, confidence, competence	CINAHL	3	3	0 One article was good but already had article from pub med search excluded ICU MD's, LMA's, and vocal cord damage after neuromuscular agents	
26 Jan 11 #3	confidence, simulation	CINAHL	539	6	4 Advocates pros of simulation training among healthcare workers— however, not fiberoptic or anesthesia	Level VI/Baillie  Level III/Blum  Level VII/Cumin  Level VI/Smith
4 Feb 11 #4	confidence,simulation anesthesia	CINAHL	3	0	0 Excluded different surgeries, statistical analysis, PACU settings	
4 Feb 11 #5	confidence, intubation, anesthesia	CINAHL	43	0	0	
26 Jan 11 #6	confidence, fiberoptic intubation, anesthesia	CINAHL	2	0	0	
26 Jan	confidence,	CINAHL	0	0	0	

11 #7	simulation, fiberoptic intubation					
22 Mar 11 #8	confidence, intubation simulation	CINAHL	4	2	1	Level VI/Davis

LMA= laryngeal mask airway; ICU=intensive care unit; MD=medical doctor; PACU=post anesthesia care unit

## Appendix C

### Databases Searched and Data Abstraction PubMed Searches

Date of Search	Keyword Used	Database/Source Used (CINAHL, PubMed & Cochrane)	# of Hits			Rating System/Author
			Listed	Reviewed	Used	
19 Feb 11 #1	fiberoptic intubation, simulation	PubMed	7	7	1 Excluded legal claims for difficult airways, other devices, and damage to vocal cords	Level II/Rowe
19 Feb 11 #2	fiberoptic intubation, confidence, competence	PubMed	15	2	1 Excluded surgical procedures, ICU MD's	Level II/Kovacs
19 Feb 11 #3	confidence, simulation	PubMed	2641	Refined search	A lot of articles that tout the benefit of simulation and confidence levels	
19 Feb 11 #4	confidence, simulation, anesthesia	PubMed	49	5	1 Excluded: generalized simulation and self- efficacy competence simulation and education, simulation and epidurals & various drugs— none on fiberoptic intubations	Level VI/Chen
19 Feb 11 #5	confidence, intubation, anesthesia	PubMed	256	Refined search	Nothing applicable	
19 Feb 11 #6	confidence, fiberoptic intubation, anesthesia	PubMed	10	1 Already had article from another search	0 Eliminated other diseases and airway adjuncts	
19 Feb 11 #7	confidence, simulation, fiberoptic intubation	PubMed	11	2 Already have from previous	No data on specific area of study. Excluded novice	

				search results	intubators, pre-hospitalization, some on plain intubations, not fiberoptic	
22 Mar 11 #8	confidence, intubation, simulation	PubMed	11	2	1 Two were good but already had one from previous search	Level VI/Russo

ICU=intensive care unit; MD=medical doctor

## Appendix D

### Databases Searched and Data Abstraction for Cochrane Searches

Date of Search	Keyword Used	Database/Source Used (CINAHL, PubMed & Cochrane)	# of Hits			Rating System/Author
			Listed	Reviewed	Used	
4 Mar 11 #1	fiberoptic intubation, simulation	Cochrane	0	0	0	
4 Mar 11 #2	fiberoptic intubation, confidence, competence	Cochrane	0	0	0	
4 Mar 11 #3	confidence, simulation	Cochrane	0	0	0	
4 Mar 11 #4	confidence, simulation, anesthesia	Cochrane	0	0	0	
4 Mar 11 #5	confidence, intubation, anesthesia	Cochrane	0	0	0	
4 Mar 11 #6	confidence, fiberoptic intubation, anesthesia	Cochrane	0	0	0	
4 Mar 11 #7	confidence, simulation, fiberoptic intubation	Cochrane	0	0	0	
4 Mar 11 #8	confidence, intubation simulation	Cochrane	0	0	0	

## Appendix E

### Overview of Articles

Final Evaluation Table

First Author (Year)  Article 1	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and their definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Rowe & Cohen, (2002)	none	RCT	n = 20 pediatric residents  12 received simulator training  8 received no simulator training  Setting: Children's Hospital Oakland	IV: flexible bronchoscopy simulator  DV1: Time to intubation  DV2: Number of times scope hit mucosa	Intubations were videotaped and timed. Tapes were scored by anesthesia attending who were blinded to subject identity and group	Residents who had never performed FOI improved dramatically compared with the control group who showed no significant change between the two cases.	The study showed that the simulator was successful at training residents the psychomotor skills necessary to intubate pediatric patients with a fiberoptic bronchoscope. Residents who had never performed fiberoptic intubation improved dramatically compared with the control group who showed no significant change between two cases.	Strength: simulator training can decrease the amount of time it takes a resident to complete an intubation. Residents can successfully be taught the psychomotor skills of FOI in pediatric patients by using the simulator.  Weaknesses: not nurse anesthetists  Confidence levels not measured  Conclusion: because the simulator poses no risk to any patient, it would be an ideal instructional tool for providers in practicing FOI

First Author (Year)  Article 2	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and their definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Kovacs et al., (2007)	None	Randomized crossover study Randomized only to use of which device they would use first, the bougie or the fiberoptic scope.	n = 133  Inexperience laryngoscopists used.	IV 1: Bougie and fiberoptic stylet.  IV 2: Two different views to the airway were used 1) grade 3A view (only epiglottis can be seen, but it can be lifted) or 2) grade 3b view (only epiglottis can be seen but it cannot be lifted up and away from the posterior pharyngeal wall).  DV 1: Timing of the placement of the ETT.  DV2: correct placement of the ETT.	Both airway devices were timed for correct placement of the ETT.	3A view: Correct placement of the ETT was achieved in 101 (98%) of the fiberoptic stylet-facilitated and all 103 (100%) of the bougie-facilitated tracheal intubations. The time to successful tracheal intubation was similar for both devices (difference mean time 1.8 seconds; 95% CI-2.5- 6.1 seconds).  3B view: Use of the fiberoptic stylet significantly increased success rate (fiberoptic stylet 98%), and a trend was observed toward a decrease in the mean time required for successful tracheal intubation compared to the bougie (fiberoptic stylet 31.0 seconds versus bougie 45.6 seconds; difference in mean time- 14.6 seconds; CI: 95%- 31.4-2.3 seconds).	In the easier grade 3A view both devices were effective in intubating  In the more difficult 3B view, the fiberoptic stylet was significantly more effective than the bougie in facilitating tracheal intubation.	Strengths: Fiberoptic adjuncts work better on the difficult airways.  Weaknesses: Unskilled laryngoscopists.  Confidence levels not assessed prior or after practicing.  Because the mannequin model eliminates some of the barriers to use of fiberoptics in patients, further validation of fiberoptic stylet use is needed on human subjects.



First Author (Year)  Article 3	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and their definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Blum et al., (2010)	Tanner's Clinical Judgment Model	<p>Quasi experimental, quantitative.</p> <p>Randomization was limited due to student schedules and prior commitments.</p> <p>13 week course for health assessment skills. One groups used simulators and one group did traditional clinical studies.</p>	<p>N= 53 entry level baccalaureate nursing students.</p> <p>N=16 control N= 37 experimental simulation enhancing.</p>	<p>IV 1: HFS</p> <p>IV 2: traditional clinical experience.</p> <p>DV 1: confidence survey.</p> <p>DV 2: Competence scores.</p>	<p>Lancaster Clinical Judgment Rubric (measured students self- confidence) Independent- sample t-tests revealed no statistically significant differences between mean self-confidence scores of students in the two lab groups at either midterm or final assessment point. The possible range of scores was 4 (beginning) to 16 (exemplary). Nonetheless, a trend was noted for greater change in self-confidence among students in the traditional group compared to the simulation group.</p> <p>Similarly, t-tests evaluating mean faculty ratings of student competence by lab groups revealed no statistically significant differences at either assessment point. Students in the traditional group evidenced a greater increase in clinical competence compared to the sim group.</p>	<p>Analyzed with SPSS version 17.</p> <p>The internal consistency for the four Lasater items used to define student self-confidence, measured with Cronbach's alpha was .810</p> <p>Student midterm and final self-confidence ratings correlated positively (<math>r=.483</math>, <math>p=.001</math>) and were significantly different (<math>t=5.100</math>, <math>df=52</math>, <math>p=.000</math>).</p> <p>Furthermore, cross tabulations for the overall sample revealed 27 students rated their self- confidence in the "exemplary" range at the final assessment compared to 16 at midterm.</p>	<p>Overall improvement in self-confidence and competence in both the sim groups and the traditional lab group.</p>	<p>Strength: confidence improved with simulation.</p> <p>Weakness: Both groups improved with practice whether it was simulation or traditional learning.</p> <p>No mention of past clinical experiences or life experiences.</p>

First Author (Year)  Article 4	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and their definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Baillie & Curzio, (2008)	None identified	Descriptive	Nursing students in the United Kingdom N=267.  179 experienced simulation 88 took usual clinical placement	IV 1: simulation group  IV 2: control group  DV1: questionnaire on confidence with skills	Questionnaires were developed by faculty.	Descriptive statistics.  Chi square was used to examine associations where appropriate  Question: how confident are you about your skills? Sim grp: 23% very confident, 65% confident; 12% not confident.  Comparison grp: 15% very confident; 76% confident; 9% not confident.	At end of placements, most sim groups students were confident about their skills and confidence levels All the program facilitators and most students (93%; n=157/169) agreed that simulation enabled repeated skills practice enhancing confidence.	Strength: Sim groups improved confidence levels  Weakness: regular clinical rotation students also improved confidence levels.  Actual clinical practice with skills and confidence is not confirmed.  Sim learning appears to be at least as effective as learning during practice placement without simulation.

First Author (Year)  Article 5	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and their definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Smith & Roehrs, (2009)	Nursing education simulation framework, Jeffries (2007)	Descriptive, correlational study	N=68 junior nursing students  School of nursing at a public university in traditional BSN program	IV 1: High fidelity simulation  DV 1: Student satisfaction  DV 2: self confidence	Descriptive statistical analysis, and correlational statistical analysis using bivariate statistics (Spearman's rho) Instruments: 1.a research designed demographic instrument, 2.the Student Satisfaction and Self-Confidence in Learning Scale 3. the Simulation Design Scale Content validity.	There were 5 objectives and ratings of 1 ( strongly disagree) and 5 (strongly agree )	Clear objectives and appropriate challenging scenarios correlated with student satisfaction and self-confidence.	Strength: self confidence can increase in sim lab if objectives are clear.  Weakness: Need variety of student backgrounds, larger sample size, multiple experiences.

First Author (Year)  Article 6	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and their definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Goldman & Steinfeldt, (2006)	None identified	Observational study	University anesthesia department  N=19 (15 anesthesia residents, 4 anesthesia attendings).	IV 1: virtual airway simulator  DV 1: time to intubation using simulator  DV 2: time to intubation using a cadaver	Time to intubation	Residents were significantly able to improve time to intubation in the VR scenario (114 vs. 75 sec; $p=0.001$ ).  Novices who had been trained in sim performed better on cadaver than novices with no VR training (24 vs 86 sec; $p<0.001$ ).  No difference between trained anesthesiologists and the novice group after sim training when intubating cadavers (24 vs 23 sec; $p>0.05$ ).	All participants improved time to intubate after practicing with VR airway simulator.  Use of a VR airway sim enables anesthesia residents to acquire basic FOI skills comparable to those of experienced anesthesiologists in a human cadaver.	Strengths: used novice intubators as well as seasoned anesthesiologists.  Practicing with VR airway improved intubation skills.  VR airway sim assessment can be used for assessment of FOI performance.  Weakness: No assessment was done during a FOI on a real patient.

First Author (Year)  Article 7	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and their definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Davis et al., (2006)	None identified	Descriptive analysis, historical review Comparison of airway success before sim training and after training.	Air crews in Southern California and Nevada  A total of 504 new intubations were done after training over a 17 month period.	IV 1: simulation training  DV 1: did intubation success rates increase after simulation training?  DV 2: Did confidence increase after sim training?	A single individual reviewed all charts and abstracted data for this analysis  For confidence levels, participants completed a self-assessment confidence with airway management before training and then again after sim training.	Successful intubation was 71.3% and 89.3% and improved after sim training to 87.5% and 94.6% (n=504).  crew members reported improvements in confidence with regard to all aspects of airway management following the sim workshop.	Improvements in intubation success rates and confidence levels all improved after simulation training.	Strengths: Improvement in airway intubations and confidence levels improved after sim training.  Weakness: This did not address FOI, only regular intubation techniques Simulation alone may not improve the success rate of intubations. It may also be the educational tools, enthusiastic instructors, and emphasis on airway management

First Author (Year)  Article 8	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and their definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Russo et al., (2007)	None identified	Survey instrument	University hospital N=48	<p>IV 1: Four consecutive courses with identical structure and content on airway management using a simulator.</p> <p>DV 1: Did the course change attitude and behavior of participants in their clinical practice?</p> <p>DV 2: Any changes made in airway management.</p> <p>DV 3: Did they obtain any new airway adjuncts</p> <p>DV 4: Did course teaching or training or airway management at home departments.</p>	Questionnaire given before the course and after the course.	<p>DV 1: 29% stated they changed their clinical practice after attending the course.</p> <p>DV 2: 6% changed educational practice.</p> <p>29% made organizational changes in their departments</p> <p>DV 3: 21% acquired new airway devices</p> <p>DV 4: 41% would attend a similar course again.</p>	The combination of lectures, skill stations and scenarios facilitates transfer of knowledge and skills into daily clinical practice.	<p>Strength: Sim course on airway management had a significant impact on self-reported accuracy and confidence in evaluation of airways.</p> <p>Various intubation techniques were used including FOI.</p> <p>Weakness: Questionnaires were anonymous so we do not know which field of medicine improved in skills or confidence.</p> <p>There was limited medical background information in questionnaires.</p> <p>Attitudes and behaviors not evaluated.</p>

First Author (Year)  Article 9	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and their definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Chen et al., (2008)	None identified	Descriptive-- Lecture and demonstration was done on a simulator for the course.	N=189 Taiwan nurse anesthetists and young residents.	IV: 4 hour renewal program for airway management.  DV 1: confidence with difficult airways DV 2: decision making and communication capabilities.  DV 3: skills of specific airway management.	Questionnaire was given 6 months after training program.	Survey asked questions on overall satisfaction, if goals were met, and gave scores for lectures, multimedia, realism, equipment environment, usefulness, abilities and familiarity....overall evaluations were positive.	Opinion only: that anesthetists can update knowledge about difficult airway management from lectures, instructor based medical simulation.	Strength: the majority of students were experienced airway experts.  Weakness: positive surveys seemed to lead to the conclusion that confidence would increase even though no confidence questions were specifically asked.

First Author (Year)  Article 10	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and their definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Cumin et al., (2010)	None identified	Overview and illustrative examples	Opinion of author	none	The Society for Simulation in healthcare has recently published accreditation standards for simulation programs in Healthcare. While these standards are a start, they are general in nature.	Opinion of author-- Aviation has reproducible standards and defined benchmarks to provide some surety to users that a simulator will function to the required standard.  Healthcare simulation —some standards can be applied widely but others, like anesthesia, depends on the pharmacology of drugs and sophisticated interactions with patients and their diseases.	It is widely accepted confidence results that simulation in areas such as aviation, nuclear power and the military; therefore, if healthcare would have standards for simulation we could also have confidence that our simulation training is accepted and would be beneficial.	Strength: simulation is proven to be effective in many professions.  Simulation reduces risk and inconvenience to participants.  Simple mouth and airway simulators can be used solely for practicing airway without all the other physiologic problems.  Weakness: Healthcare simulations standards vary due to the unreliability of the patients in the real world. The simulators cannot adapt to every human situation and all the various parameters of each patient.  Key challenge in



								developing standards for anesthesia simulators lies in the potentially overwhelming nature of the task.
ETT= endotracheal tube, IV= independent variable, DV= dependent variable, FOI= fiberoptic intubation, BSN= bachelor of science in nursing, VR= virtual reality, VS= versus, sec= seconds Grp= groups								

## Appendix F

### Pamela Jeffries Permission to Use Questionnaire

From: pjeffri2@son.jhmi.edu  
To: kscx4@hotmail.com  
Date: Mon, 10 Oct 2011 16:51:05 -0400  
Subject: RE: Use of Student satisfaction questionnaire with a change in wording

Scott,  
I have no problem with you changing the words; good luck with your DNP project! Please let me know if you need anything else.

Best,  
Pam

Pamela R. Jeffries PhD, RN, FAAN, ANEF  
Professor  
Associate Dean for Academic Affairs  
Johns Hopkins University School of Nursing  
525 North Wolfe Street, Room 465  
Baltimore, Maryland 21205-2110  
410-614-4081/Fax 410-955-7463  
[pjeffri2@son.jhmi.edu](mailto:pjeffri2@son.jhmi.edu)

---

**From:** scott r moore [kscx4@hotmail.com]

**Sent:** Monday, October 10, 2011 3:39 PM

**To:** Jeffries, Pamela; Moore Kelley C LtCol 88 SGOS/SGCJ

**Subject:** Use of Student satisfaction questionnaire with a change in wording

Dr. Jeffries:

My name is Kelley Moore and I am in the DNP program at Wright State University in Dayton, Ohio. I am doing a project for nurse anesthetists where they will practice with a fiberoptic scope on high-fidelity mannequins. I was hoping to use the NLN's Student Satisfaction and Self-Confidence in Learning questionnaire after they practice in the simulation lab. I asked for permission from the NLN to use the questionnaire and to change the wording in question number two and seven from:

"medical surgical"

to:

2) The simulation provided me with a variety of learning materials and activities to promote my learning the "airway management" curriculum.

7) I am confident that this simulation covered critical content necessary for the mastery of "airway management" curriculum.

I was told I needed your permission for any word change. Would this be alright to use my wording for these two questions?

It is quite an honor to even email you! I read your name everywhere!

Thank you for your time,

Kelley Moore

[kscx4@hotmail.com](mailto:kscx4@hotmail.com)

[kelley.moore@wpafb.af.mil](mailto:kelley.moore@wpafb.af.mil)

## **Appendix G**

### **NLN Permission**

It is my pleasure to grant you permission to use the “Educational Practices Questionnaire,” “Simulation Design Scale” and “Student Satisfaction and Self-Confidence in Learning” NLN/Laerdal Research Tools. In granting permission to use the instruments, it is understood that the following assumptions operate and "caveats" will be respected:

1. It is the sole responsibility of (you) the researcher to determine whether the NLN questionnaire is appropriate to her or his particular study.
2. Modifications to a survey may affect the reliability and/or validity of results. Any modifications made to a survey are the sole responsibility of the researcher.
3. When published or printed, any research findings produced using an NLN survey must be properly cited as specified in the Instrument Request Form. If the content of the NLN survey was modified in any way, this must also be clearly indicated in the text, footnotes and endnotes of all materials where findings are published or printed.

I am pleased that material developed by the National League for Nursing is seen as valuable as you evaluate ways to enhance learning, and I am pleased that we are able to grant permission for use of the “Educational Practices Questionnaire,” “Simulation Design Scale” and “Student Satisfaction and Self-Confidence in Learning” instruments.

**Nasreen Ferdous | Administrative Coordinator for Grants/R&PD | National League for**

**Nursing | [www.nln.org](http://www.nln.org)**

**nferdous@nln.org | Phone: 212-812-0315 | Fax: 212-812-0391 | 61 Broadway | New York, NY**

**10006**

## Appendix H

### Wright State University Approval



Office of Research and Sponsored Programs  
201J University Hall  
3640 Col. Glenn Hwy.  
Dayton, OH 45435-0001  
(937) 775-2425  
(937) 775-3781 (FAX)  
e-mail: rsp@wright.edu

**DATE:** August 28, 2012

**TO:** Kelley C. Moore, M.S.N, CRNA, Doctoral Student  
School of Nursing  
Sherrill Smith, Ph.D., Faculty Advisor

**FROM:** Bette Sydelko, MS.L.S., M.Ed. *fjJ*  
Facilitator, Expedited Review Advisory Committee

**SUBJECT:** SC#4863

*'Simulation Training for Fiberoptic Intubations'*

This memo is to verify the receipt and acceptance of your response to the conditions placed on the above referenced human subjects protocol/amendment.

These conditions were lifted on: 08/28/2012

This study/amendment now has full approval and you are free to begin the research project. If this is a VA proposal, you must still receive a letter of approval from the Research and Development Committee prior to beginning the research project. If this is a MVH proposal, you must still receive a letter of approval from the Human Investigation and Research Committee (HIRC) prior to beginning the research project. This implies the following:

1. That this approval is for one year from the approval date shown on the Action Form and if it extends beyond this period a request for an extension is required. (Also see expiration date on the Action Form)
2. That a progress report must be submitted before an extension of the approved one-year period can be granted.
3. That any change in the protocol must be approved by the IRB; otherwise approval is terminated.

If you have any questions concerning the condition(s), please contact Jodi Blacklidge at 775-3974.

Thank you!

Enclosure

RESEARCH INVOLVING HUMAN SUBJECTS

SC# ±8.6.1

ACTION OF THE  
WRIGHT STATE  
UNIVERSITY  
EXPEDITED  
REVIEW Assurance  
Number:  
FWA00002427

Title: *'Simulation Training for Fiberoptic Intubations'*

Principal Investigator: Kelley C. Moore, M.S.N. CRNA Doctoral Student  
Sherrill Smith, Ph.D., Faculty Advisor

Department: School of Nursing

Expedited Category: 7

The Institutional Review Board has approved the use of human subjects on this proposed project with conditions previously noted. The conditions have now been removed.

REMINDER: FDA regulations require prompt reporting to the IRB of any changes in research activity, changes in approved research during the approval period may not be initiated without IRB review (submission of an amendment), and prompt reporting of any unanticipated problems (adverse events).

IRB Meeting Date: September 17, 2012

#####.111.11111-#####  
#####.##

*Tflis approval is effective on tv tltroughlt: August 10, 2013*

To continue the activities approved under this protocol you should receive the appropriate form(s)

from Research and Sponsored Programs (RSP) two to three months prior to the required due date. If you do not receive this notification, please contact RSP at 775-2425.

#####\_#####

////



## **Appendix I**

### **Consent for Participation**

#### **INFORMED CONSENT DOCUMENT**

*XXX Medical Group*

*XXX Medical Center*

**Date of IRB Approval:** 25 June 2012

**Date of IRB Expiration:** 24 June 2013

*This document must NOT be used past the date of IRB expiration. New approval must be obtained from the XXX Medical Center Institutional Review Board before approval has expired.*

**PRIVACY ISSUES:** Records of my participation in this study may only be disclosed in accordance with federal law, including the Federal Privacy Act, 5 USC 552a, and its implementing regulations, the Health Insurance Portability and Accountability Act of 1996 (HIPAA), and 45 CFR Parts 160 and 164. I have read the Privacy Act Statement contained in DD Form 2005. I understand that records of this study may be inspected by the U.S. Food and Drug Administration (FDA), the sponsoring agency and/or their designee, and the XXX Medical Center Institutional Review Board (IRB), if applicable.

#### **TITLE OF STUDY**

*Simulation Training for Fiberoptic Intubation*

#### **INVESTIGATORS' NAMES, DEPARTMENTS, PHONE NUMBERS**

*Kelley Moore, Anesthesia Department, (937) 630-2140*

#### **PURPOSE OF STUDY**

You are being asked to consider participation in a research study at XXX.

The purpose of the study is to see if the training improves competence and confidence in awake fiberoptic intubations skill after the CRNAs go through a newly developed high-fidelity simulation training program. This study will enroll 4-10 subjects over a period of one day.

#### **PROCEDURES**

Before you decide to volunteer to participate in this study, the study investigator will explain this research study to you, answer questions which you may have, and obtain your voluntary informed consent. The informed consent process will take place in a

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private setting located in vacant operating rooms at XXX. There will be a witness to the consent process in the room while consent is being obtained to prevent the possibility of coercion and/or undue influence of your decision whether or not to participate in this study. The time it will take to complete this process will depend upon your understanding of the study.

If you volunteer to participate in this study, we will ask you to do undergo the following procedures. You will be timed on one fiberoptic intubation before any training begins. There will be a one-hour difficult airway lecture. After the lecture, the participants will go to a vacant operating room where there will be 4 high-fidelity mannequins used with various types of airways. The subjects/participants will get to practice numerous times using the fiberoptic scope on all the mannequins and review protocols to numb the back of the throat in preparation for the awake fiberoptic intubation. When the subjects feel comfortable, they will be timed again on the intubation with the fiberoptic scope.

There is also a 13 question questionnaire from the National League of Nursing on Student Satisfaction and Self-Confidence in Learning that will be given at the end of the course. All the answers and the timed intubations will be confidential. ***The total time for this participation is approximately 4 hours.***

#### **RISKS/INCONVENIENCES**

***The risks are minimal to none. A possibility of performance anxiety may occur. Every effort will be made to train in a nonthreatening, comfortable environment. The purpose of this systematic investigation is to contribute to the general knowledge of how to best teach CRNAs the skill of awake fiberoptic intubations.***

#### **BENEFITS**

The possible benefit of your participation is the potential to learn advanced skills in fiberoptic intubations.

Patients may benefit by having providers with increased levels of confidence and competence when doing this advanced airway technique.

#### **ALTERNATIVES**

Choosing not to participate is an alternative to participating in this study.

#### **EVENT OF INJURY**

Your entitlement to medical and dental care and/or compensation in the event of injury is governed by federal laws and regulations, and if you have questions about your rights or if you believe you have received a research-related injury, you may contact the Director of

Clinical Investigations at XXX, the Chief of the Medical Staff at XXX, or the investigator at XXX.

Should you be injured as a direct result of being in this study, you will be provided medical care for that injury at no cost. You will not receive any compensation (payment) for injury. This is not a waiver or release of your rights. Medical care is limited to the care normally allowed for XXX health care beneficiaries (patients eligible for care at XXX hospitals and clinics). Necessary medical care does not include in-home care or nursing home care. In case of any medical incident, you will be treated at the clinic or Emergency room at XXX.

#### **OCCURRENCE OF UNANTICIPATED ADVERSE EVENT**

If an unanticipated event occurs during your participation in this study, you will be informed immediately. If you are not competent at the time to understand the nature of the event, such information will be brought to the attention of your next of kin.

#### **CONFIDENTIALITY**

The timed intubations will be recorded by the subject on an index card that is in an envelope. The subjects are asked to put a date that is only important to them on the envelope. The index card or envelope will be left in the operating room. Thus, researchers will not be able to associate your identity with any of your results.

#### **DECISION TO PARTICIPATE**

The decision to participate in this study is completely voluntary on your part. You may choose not to take part in the study. The project director will answer any questions you have about this study, your participation, and the procedures involved. The project director will be available to answer any questions concerning procedures throughout this study. If significant new findings develop during the course of this study that may relate to your decision to continue participation, you will be informed.

You may withdraw your consent at any time by not participating, not turning in your index card or not filling out the questionnaire at the end of the training program

Your decision will not affect your eligibility for care or any other benefits to which you are entitled.

#### **Questions About Research**

If you have any questions about the research project, you may contact the principal investigator at XXX-XXXX or the faculty advisor, Dr. Sherrill Smith at 775-2665. If you have general questions about giving consent or your rights as a research participant in this research study, you can call the Wright State University Institutional Review Board Coordinator at 937-775-4462.

**I have read all of the above. My questions have been answered concerning areas I did not understand. I am willing to take part in this study. After I sign this form, I will receive a copy.**

\_\_\_\_\_  
(Subject's Printed Name)

(\_\_\_\_) \_\_\_\_\_  
(FMP & XXX SSN)

\_\_\_\_\_  
\*(Subject's Signature)

\_\_\_\_\_  
(Date & Time)

(\*if the subject is a minor, it is recommended that both parents/guardians sign the ICD (if possible)

\_\_\_\_\_  
(Advising Investigator's Signature)

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Witness's Signature)

\_\_\_\_\_  
(Date)

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## **Appendix J**

### **Protocol (1) for Awake Fiberoptic Intubation**

\*Note: many of these techniques are interchangeable depending on provider preference

1. Put patient on monitors.
2. Know the Lidocaine toxicity limit for your patient.
3. Explain to patient what you plan to do. This will help decrease his anxiety.
4. Glycopyrrolate 1-2 cc (0.2-0.4mg). This will dry out patient's secretions. Be sure and give it time to be effective—at least 15 minutes.
5. Put 5% Lidocaine paste on a mouth swab and have patient put it in the back of his throat and suck on it. Let the Lidocaine dissolve.
6. Start Precedex (Dexmedetomidine) drip 1mcg/kg/hr. (May have to go down to 0.5 mcg/kg/hr. The range for Precedex drip is: 0.2-1 mcg/kg/hr. Watch for decreasing heart rate).
7. Put 4% Lidocaine in an atomizer. If no atomizer, take a syringe with a small angiocatheter attached to end and spray in 4% topically.
8. Have patient in a sitting position (position is key—patient is awake and breathing normally in this position).
9. Have Propofol and induction agents in line.
10. You can come in with the fiberoptic scope from the front of the patient or have the patient lie flat.
11. Have patient open his mouth.
12. Place Endotracheal tube (ETT) over scope, place scope midline and advance down back of throat.

13. As soon as you see glottis, you can squirt 2-5 cc of Lidocaine on cords if desired  
(place epidural catheter through side port of scope and use that to squirt in the  
Lidocaine onto the cords-patient will cough).
14. Advance ETT into trachea. Advance on inspiration.
15. Watch placement through fiberoptic eye piece as you take scope out.
16. Induce patient off to sleep for procedure.

(Input for protocols received from anesthesiologists: D. Kaffenberger, E. Nelson, A. Vaclavik and CRNA,  
D. Gilmer).

## **Appendix K**

### **Protocol (2) for Awake Fiberoptic Intubation**

1. Put patient on monitors.
2. Know the Lidocaine toxicity limit for your patient.
3. Explain to patient what you plan to do. This will help decrease his anxiety.
4. Glycopyrrolate 1-2 cc (0.2-0.4mg). This will dry out patient's secretions. Be sure and give it time to be effective—at least 15 minutes.
5. Sedation may be given. Use drugs judiciously without major boluses of any one drug. Stick with 1-2 drugs only. Avoid polypharmacy techniques. Keep reversal drugs nearby. Versed, opioids, Droperidol, Haldol, Benadryl, Precedex or Remifentanyl (0.75 mcg/kg loading dose with 0.075 mcg/kg/min as maintenance) can all be used.
6. Squirt Afrin into each nares twice to decrease the risk of bleeding. Many times awake intubations move from oral intubation to nasal intubation; therefore, it is necessary to prepare the nose for nasal intubation as well.
7. Take a large cotton swab and soak with 4% or 5% lidocaine. Place in nose. Advance until patient winces. Numbing the nares may take up to 5 minutes.
8. Take a new set of 4% or 5% Lidocaine soaked large swabs or paste and insert along the tongue until the patient retches. Now you know you are in the right spot. Back off slightly and a few moments later, advance again. Eventually, the patient will be able to close his mouth around the swabs and hold in place for 5 minutes. This will get the base of the tongue and the posterior oropharyngeal wall. \*Note: a

nasal trumpet soaked with 5% lidocaine paste will also work if you do not have large cotton swabs.

9. Get a 10 cc syringe with a large plastic angiocath and fill it with 2% Lidocaine. Patient sticks out his tongue and anesthesia provider holds tongue with a gauze pad. Drip the Lidocaine on to the tongue base. Patient will cough. Slowly continue to drip the lidocaine at the base of the tongue. Once the coughing stops, you can let go of the tongue. Holding the tongue prevents the patient from swallowing the lidocaine. You do not need to give the whole 10cc of lidocaine. This will numb up the hypopharynx/larynx and trachea.
10. Have patient in sitting position for awake intubation is preferred because the patient has less chance of obstructing his airway and this position best optimizes airway anatomy.
11. An Ovassapian tube can be place in mouth with a nasal trumpet taped to the inside of it. Slit the nasal trumpet lengthwise down the top of the tube. Cut the end of the nasal trumpet so not much is sticking out past the end of the Ovassapian tube. This way you can peel it off easily after you place the ETT. Secure the nasal trumpet to the Ovassapian tube with a piece of tape. This will guide the fiberoptic scope midline and should get you close to the glottis opening.
12. Place the scope through the nasal trumpet that is secured to the Ovassapian tube.
13. Once you see the cords, advance ETT on inspiration (you can have epidural cath threaded through side port of scope with lidocaine in syringe to squirt cords if you feel it is necessary).
14. Watch through the scope as you pull the fiberoptic scope out of the ETT.



### 15. Induce patient.

(Input for protocols received from anesthesiologists: D. Kaffenberger, E. Nelson, A. Vaclavik and CRNA, D. Gilmer).

## Appendix L

### Protocol (3) for Awake Fiberoptic Nasal Intubation

1. Put patient on monitors.
2. Know the Lidocaine toxicity limit for your patient.
3. Explain to patient what you plan to do. This will help decrease his anxiety.
4. Glycopyrrolate 1-2 cc (0.2-0.4mg). This will dry out patient's secretions.  
clonidine Be sure and give it time to be effective—at least 15 minutes.
5. Sedation may be given. Use drugs judiciously without major boluses of any one drug. Stick with 1-2 drugs only (Versed is good to use). Avoid polypharmacy techniques. Keep reversal drugs nearby.
6. Use 3 drops of Phenylephrine nasal drops (0.25%) in both nostrils.
7. After 5 minutes,  
  
\*5% Lidocaine paste on nasal trumpet or cotton swabs to both nares.  
  
\*Or, Lidocaine 4% liquid to nasal mucosa at both sides-squirt 3 drops and have patient inhale.
8. Take a new set of Lidocaine soaked 4% or 5% swabs and insert along the tongue until the patient retches. Now you know you are in the right spot. Back off slightly and a few moments later, advance again. Eventually, the patient will be able to close his mouth around the swabs and hold in place for 5 minutes. This will get the base of the tongue and the posterior oropharyngeal wall. Even though this is a nasal intubation, unless you numb up the area around the glottic opening, the patient will gag. \* Note: A nasal trumpet soaked with 5% lidocaine paste will also work if you do not have large cotton swabs.

9. Use Remifentanyl (Ultiva) loading dose of 0.75 mcg/kg over 60 seconds immediately followed by continuous infusion of 0.075 mcg/kg/min of Remifentanyl. \* Note: your drug of choice may be used here as well—you may prefer to use: Precedex, Ketamine, and Fentanyl which is fine.
10. The goal is to keep patient spontaneously ventilating with a respiratory rate of >8/minute and maintaining consciousness. Once this is achieved, slide a nasal trumpet covered with 2% lidocaine jelly down nares to dilate. May need to use a couple different sizes.
- Insert fiberoptic scope with ETT threaded on it through nose.
  - When epiglottis or vocal cords are visualized, spray 3 ml of 2% Lidocaine on the supraglottic region through the working channel of the bronchoscope.
  - Advance the nasal tube. Watch it go toward carina. Position tracheal tube midtrachea.
  - Induce for surgery.

(Input for protocols received from anesthesiologists: D. Kaffenberger, E. Nelson, A. Vaclavik and CRNA, D. Gilmer).

## **Appendix M**

### **Program Outline for Awake Fiberoptic Training**

(The whole training packet can be found on the hospitals “O” drive, SGOS, Anesthesia, Private, Simulation Training for Fiberoptic Intubations)

#### **Administrative Issues:**

- Talk with simulation laboratory staff to prep and reserve mannequins for training
- Reserve OR rooms as needed
- Gather supplies on all the protocol list  
includi([http://www.nln.org/researchgrants/nln\\_laerdal/instruments.htm](http://www.nln.org/researchgrants/nln_laerdal/instruments.htm)). ng stop-watch for timed intubations
- Have lap top in conference room for power point slides
- If this as a formal project, get permission from the IRB
- Stop-watch needed to time intubations

#### **Review with Instructors:**

- Plans for the day
- Education Principles
  - \* Encourage learning in a non-threatening environment
  - \* Adult learners lose interest if not actively involved
  - \* There are 3 types of learners: visual, auditory, tactile or kinesthetic. Use all 3 methods and encourage student participation
  - \* Reflection in Action is when the instructor pauses during the simulation to explore the action of the student or take the opportunity to teach
  - \* Avoid lecturing during the students’ simulation time
  - \* Facilitate an open dialogue
  - \* Debrief after the scenario. Debriefing is used for emotional support to help the student with supportive, immediate feedback and it is used as part of the educational factor to provide the learners to talk about the experience with respect to both the technical skills and the emotional effect of the simulation experience.

#### **Program Outline:**

- Time: 2—4 hours. Allow participants extra days/time to practice if desired.

- Time first fiberoptic intubation (FOI) (before any practice or lecture). Maintain confidentiality. IE: can give participants an envelope and they can put a date on it that only they will recognize. Place an index card in the envelope for them to put their timed scores. Index card can be given to project director to analyze results. Index cards will be kept in a locked office.
- Lecture by airway expert (1 hour)
  - use power point
  - use fiberoptic scope checklist
  - review the 3 protocols options
- Have project leader and other airway experts in room to demonstrate/guide students through FOI and various protocols they might use
- Encourage students to use FOI scopes 60 times in total on the various airways. This is the “magic” number from airway experts for obtaining this skill
- Time the FOI after the student has practiced as many times as they want on the mannequins. \*hopefully their skills improve and their time to intubation will decrease.

#### Evaluation Tools:

- The difference between the 2 timed intubations: 1) before FOI training and 2) after the airway training program
- The adapted National League of Nursing Student Satisfaction and Self-Confidence in Learning questionnaire
- Informal interviews of participants related to satisfaction